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AUTHOR	Schramm, C.: Osland, Walt
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ABSTRACT

One of twelve individualized courses included in an automotive repair curriculum, this course covers the theory, diagnoses, and overhaul of manual and automatic transmissions, drivelines, and differentials. The course is comprised of five units: (1) Clutches, (2) Standard Transmissions, (3) Automatic Transmissions, (4) Drive Shafts, and (5) Differentials. Each unit begins with a Unit Learning Experience Guide that gives directions for unit completion. The remainder of the unit consists of Learning Activity Packages (LAP) that provide specific information for completion of a learning activity. Each LAP is comprised of the following parts: objective, evaluation procedure, resources, procedure, supplemental sheets, study guide, and a LAP test with answers. The course is preceded by a pretest which is designed to direct the student to units and performance activities. (LRA)

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MOUNTAIN PLAINS LEARNING EXPERIENCE GUIDE:

Automotive Repair.

Course: Power Train.

CE027779

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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Mountain-Plains Education &
Economic Development
Program, Inc.

Glasgow AFB, Montana 59231

Learning Experience Guide

COURSE: POWER TRAIN

DESCRIPTION:

"Transmission" covers the theory, diagnoses and overhaul of manual and automatic transmissions, drivelines and differentials.

RATIONALE:

The theory and techniques covered in this course will enable a person to diagnose and repair manual and automatic transmissions, drivelines and differentials.

PREREQUISITES:

Math Skills - level as determined by the specific requirement of the particular job title.

Communication - level as determined by the specific requirement of the particular job title.

OBJECTIVE:

Adjust and replace clutches, troubleshoot and overhaul a standard transmission; inspect and replace universal joints and driveshafts; and diagnose and repair differentials for automobiles.

RESOURCES:

A resource list is attached.

GENERAL INSTRUCTIONS:

This course has **five** units. Each unit has a Unit Learning Experience Guide (LEG) that gives directions for unit completion. Each unit consists of Learning Activity Packages (LAPs) that provide specific information for completion of a learning activity. Pretesting results direct the student to units and performance activities.

The general procedure for this course is as follows:

(1) Read the assigned unit LEG for this course.

Principal Author(s): C. Schramm/W. Osland

(2) Begin and complete the first assigned LAP.
  a. Take and score the LAP test.
  b. Turn in the LAP test answer sheets.
  c. Determine the reason for any missed items on the LAP test.
  d. Proceed to the next assigned LAP in the unit.
  e. Complete all required LAPs for the unit by following steps (a) through (d).

(3) Take the unit tests as described in the Unit LEG "Evaluation Procedures".

(4) Proceed to the next assigned unit in this course.

(6) Proceed to the next assigned course.

You will work independently unless directed to do otherwise. When questions or problems arise, you are expected to discuss them with the instructor. At all times remember to follow correct safety procedures during the performance activity.

UNIT TITLES:

.01 Clutches
.02 Standard Transmission
.03 Automatic Transmissions
.04 Drive Shafts
.05 Differentials

EVALUATION PROCEDURE:

Course evaluation is by pre and post testing using a multiple-choice type of test.

In this course, the course test is used as a pretest to determine which units, if any, the student may be able to validate. The student is considered validated for a particular unit if 4 out of 5 items are correctly answered for each LAP part on the course pretest and that particular unit does not have a performance test requirement.

For those units with performance test requirements, the student must also satisfactorily complete the performance test to validate that unit. Unit performance test validation procedures are given in the "Evaluation Procedure" section of the unit Learning Experience Guide (LEG).

The course test will also be taken by the student as a post test to determine any changes resulting from taking all or part of the course. Score at least 80% correct on the post test.

FOLLOW-THROUGH:

Go to the first assigned Unit Learning Experience Guide (LEG) listed on your Student Progress Record (SPR).

3. Replacement parts (cont.)

- gaskets
  - overhead set
  - shift cover
- gasket cement
- jack, transmission
- planetary unit
- piston servo bands
- pump
- pump, front
- seal and bushing, rear three-speed
- servo band:
  - two-speed
  - three-speed
- servo pistons
- shims
- synchronizers
- transmission:
  - oil
  - lubricant
- universal joint
- valve body:
  - two-speed
  - three-speed

4. Tools, basic hand:

- chisel and punch set
  - 5/32" pin punch
  - 3/16" solid
- gauge, feeler (.002" - .025")
- hammer, ball peen
- hammer, plastic tip
- handle, speed
- hex key set
- pliers, diagonal cutting
- pliers, needle nose
- scraper, gasket
- screwdriver, standard (set)
  - screwdriver, Phillips (set)
  - screw starter
- socket set (3/8" drive)
  - extension (3")
- ratchet
- socket set (1/4" drive)
  - extension (3")
  - handle (6" flex)
  - ratchet
- socket, spark plug
  - extension (6")
- wrench, combination (set)
- wrench, combination ignition (set)

5. Tools, general:
    - C-clamp
    - cleaning fluid
    - cleaning solvent
    - compressed air
    - creeper
    - drain pan
    - drill indicator
    - fender covers
    - file
    - finishing stone
    - gauges, feeler
    - grease
    - holding fixture
    - jacks or lift
    - magnifying glass
    - press
    - press, hydraulic
    - puller
    - seal remover
    - sealant
    - slide hammer puller with adapter
    - snap ring pliers
    - thickness gauge
    - trouble lights
    - wrench, torque
    - vise
6. Tools, transmissions systems:
    - bushing driver
    - pressure gauge
7. Video-Tape player.

RESOURCE LIST

Printed Materials

1. Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc., 1974.
2. Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc., 1975.
3. Operator's Manuals.
4. Motor's Auto Repair Manual. Motor. The Hearst Corporation, 1972 (or equivalent).
5. National Service Data. Mitchell Manuals. National Service Corporation.

Audio/Visuals

1. Video Tape: Torque Converter. Mountain-Plains Education & Economic Development Company, Inc.

Equipment

1. Automobile needing:
    - throw out bearing replacement
    - pilot bushing
    - drive shaft repair
    - differential repair
    - universal joint
    - axle bearing and seal replacement
2. Automobile with:
    - automatic transmission
        - two-speed
        - three-speed
    - standard transmission
        - clutch
        - high
        - reverse
        - forward
        - one-way
    - differential unit
    - governor
        - two-speed
        - three-speed
    - propeller shaft, two piece with center support
    - rear axle assembly
3. Replacement parts:
    - transmissions
    - carrier and pinion bearing
    - bypass/pressure regulator valve
    - clutch unit
    - converter and stator
        - two-speed
        - three-speed
    - drive line components

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:
File Code: 37.11.00.00.B1-2
Name: Power Train
Family Pay Number: Sex M F (Circle 1)

ANSWERS

37.11.01.01	1.	C	37.11.01.05	21.	C	37.11.02.01	41.	C
	2.	C		22.	D		42.	B
	3.	B		23.	C		43.	A
	4.	A		24.	A		44.	A
	5.	B		25.	C		45.	A
37.11.01.02	6.	B	37.11.01.06	26.	D	37.11.02.02	46.	A
	7.	C		27.	A		47.	C
	8.	A		28.	D		48.	B
	9.	A		29.	A		49.	B
	10.	A		30.	B		50.	A
37.11.01.03	11.	A	37.11.01.07	31.	C	37.11.02.03	51.	B
	12.	A		32.	D		52.	D
	13.	D		33.	A		53.	B
	14.	A		34.	B		54.	C
	15.	A		35.	A		55.	A
37.11.01.04	16.	D	37.11.01.08	36.	B	37.11.02.04	56.	A
	17.	D		37.	A		57.	A
	18.	D		38.	C		58.	C
	19.	C		39.	C		59.	B
	20.	C		40.	B		60.	B

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:
File Code: 37.11.00.00.B1-2
Name: Power Train

ANSWERS

37.11.02.05	61.	A
	62.	B
	63.	C
	64.	D
	65.	A
37.11.02.06	66.	D
	67.	D
	68.	A
	69.	B
	70.	D
37.11.02.07	71.	C
	72.	D
	73.	D
	74.	B
	75.	A
37.11.02.08	76.	D
	77.	D
	78.	A
	79.	D
	80.	A
37.11.02.09	81.	C
	82.	D
	83.	C
	84.	C
	85.	A
37.11.02.10	86.	D
	87.	D
	88.	C
	89.	B
	90.	D
37.11.02.11	91.	A
	92.	D
	93.	D
	94.	A
	95.	D
37.11.03.01	96.	D
	97.	D
	98.	D
	99.	B
	100.	C
37.11.03.02	101.	A
	102.	A
	103.	C
	104.	B
	105.	D
37.11.03.03	106.	D
	107.	A
	108.	C
	109.	B
	110.	A
37.11.03.04	111.	B
	112.	C
	113.	B
	114.	B
	115.	D
37.11.03.05	116.	C
	117.	D
	118.	A
	119.	A
	120.	A

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:
File Code: 37.11.00.00.B1-2
Name: Power Train

ANSWERS

37.11.03.06	121.	B	37.11.04.03	141.	C	37.11.05.04	161.	D
	122.	A		142.	B		162.	C
	123.	A		143.	D		163.	A
	124.	A		144.	A		164.	D
	125.	A	37.11.04.04	145.	A		165.	A
37.11.03.07	126.	A	37.11.05.01	146.	C	37.11.05.05	166.	B
	127.	B		147.	D		167.	B
	128.	D		148.	B		168.	D
	129.	B		149.	C		169.	C
	130.	D		150.	C		170.	A
37.11.04.01	131.	D	37.11.05.02	151.	D	37.11.05.06	171.	B
	132.	B		152.	A		172.	C
	133.	C		153.	A		173.	B
	134.	D		154.	B		174.	B
	135.	A		155.	C		175.	A
37.11.04.02	136.	B	37.11.05.03	156.	D	37.11.05.07	176.	B
	137.	A		157.	D		177.	D
	138.	B		158.	D		178.	C
	139.	C		159.	A		179.	C
	140.	B		160.	B		180.	A

COURSE PRETEST ANSWER KEY: POWER TRAIN

Occupational Area:
File Code: 37.11.00.00.B1-2
Name: Power Train.

ANSWERS

37.11.05.08 181. B
182. B
183. A
184. C
185. D
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240.

Student: ______________________ File Code: 37.11.00.00.B1-2

Date: ______________________ Date Published: 3-18-76

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Glasgow AFB, Montana 59231

COURSE POST TEST: POWER TRAIN

37.11.01.01

1. The clutch side of a flywheel is:
   a. constructed of a starting gear ring.
   b. machined smooth.
   c. corrugated.
   d. mounted to the crankshaft.

2. A clutch is made basically of how many parts?
   a. 6
   b. 4
   c. 1
   d. 5

3. The throw-out bearing sleeve is moved in and out by a:
   a. clutch release lever.
   b. throw-out fork.
   c. pressure plate spring.
   d. flywheel.

4. The hub splines engage:
   a. splines on the camshaft.
   b. splines on the crankshaft.
   c. splines on the transmission input shaft.
   d. splines on the clutch disc.

5. Release levers in a clutch are in what group?
   a. spindal hub assembly.
   b. starter ring gear assembly.
   c. pressure plate assembly.
   d. flywheel assembly.

37.11.01.02

6. When your pilot bearing is worn, you can remedy it by:
   a. installing new pressure plate.
   b. adjusting fingers.
   c. replacing it.
   d. adjusting linkage.

37.11.01.02 (continued)

7. You need to remove what first before you can remove the throw-out bearing?

   a. transmission.
   b. pressure plate.
   c. clutch plate.
   d. throw-out fork.

8. It is a good safety practice to do what before you start working on a throw-out bearing?

   a. disconnect battery.
   b. drain transmission.
   c. have the correct tools available.
   d. be sure car is in gear.

9. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:

   a. inspection pan.
   b. transmission.
   c. clutch cover.
   d. pressure plate.

10. When you have insufficient pedal-free travel, you can fix it by:

   a. grinding the disc.
   b. aligning pilot bearing.
   c. adjusting linkage.
   d. replacing disc.

37.11.01.03

11. What kind of lubricant do you use on the throw-out bearing shaft?

   a. high temperature grease.
   b. graphite.
   c. none.
   d. light oil.

12. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:

   a. inspection pan.
   b. transmission.
   c. clutch cover.
   d. pressure plate.

13. Name one type of throw-out bearing.

   a. graphite.
   b. hydraulic.
   c. aluminum.
   d. bronze.

37.11.01.03 (continued)

14.

a.
b.
c.
d.

15. A new throw-out bearing is generally installed every:

a. time you overhaul your clutch.
b. 25,000 miles.
c. year, or after 30,000 miles.
d. six months.

37.11.01.04

16. How many different types of pilot shaft bearings are there?

a. 2
b. 1
c. 3
c. 4

17. A defective pilot shaft bearing will make noise:

a. whtn the clutch is disengaged fully.
b. all the time.
c. when the clutch is disengaged half way.
d. when the clutch is fully engaged.

18. The pilot bushing is located:

a. in the clutch disc.
b. in the pressure plate.
c. in the crankshaft.
d. in the cluster gear.

19. What is used to take off a pilot bushing?

a. your giners.
b. a small hammer.
c.a a pry bar.
d. a threaded puller.

20. What part fits into the pilot bushing?

a. clutch disc.
b. throw-out sleeve.
c. input shaft.
d. throw-out bearing.

37.11.01.05

21. Excessive pedal-free travel can cause:

    a. throw-out fork wear.
    b. clutch slipping.
    c. hard shifting.
    d. fast throw-out bearing wear.

22. Average free-pedal travel is about:

    a. 1
    b. 3
    c. 4
    d. 1/8

23. Pedal-free travel is adjusted by:

    a. aligning the clutch housing.
    b. bending the pedal stop.
    c. adjusting the clutch linkage.
    d. placing shims under the clutch cover.

24. Insufficient pedal-free travel can cause:*

    a. excessive throw-out bearing wear.
    b. hard shifting.
    c. clutch slipping.
    d. rapid clutch disc wear.

25. Before removing the clutch cover fasteners, always:*

    a. block the flywheel.
    b. check for disc warpage.
    c. wipe them off.
    d. prick punch the cover and flywheel.

37.11.01.06

26. When removing the clutch, you should first disconnect the:

    a. transmission.
    b. flywheel.
    c. distributor.
    d. battery.

27. Before removing the transmission when replacing a clutch, it is advisable to:**

    a. drain transmission.
    b. block flywheel.
    c. jack up the engine.
    d. loosen clutch housing bolts.

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1969, page 24-16, #s 3, 15, 22).

**(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1969, page 231, Figure 12-27).

37.11.01.06 (continued)

28. In replacing a clutch, which one of the following is taken off first?

    a. universal joints.
    b. drive shaft.
    c. transmission.
    d. flywheel.

29 You disconnect the drive shaft by:

    a. taking the flywheel off.
    b. taking off the transmission.
    c. disconnecting linkage.
    d. taking off a universal joint.

30. In replacing a clutch, which of the following is removed secondly?

    a. universal joints.
    b. drive shaft.
    c. transmission.
    d. flywheel.

37.11.01.07

31. On a hydraulic linkage you should first check what, if your free travel is not correct?

    a. lever-struts.
    b. throw-out lever.
    c. cylinder fluid level.
    d. pressure palte.

32. When adjusting linkage, you check for:

    a. free play.
    b. clutch vibration.
    c. clutch temperature.
    d. pressure plate freeness.

33. Name one type of procedure used to activate the throw-out fork:

    a. torque.
    b. pedal.
    c. push rod.
    d. hydraulic.

34. The amount of travel for a clutch pedal before it comes into contact with the release levers is usually:

    a. 1/4 inch.
    b. 1/2 inch.
    c. 1 inch.
    d. 2 inches.

37.11.01.07 (continued)

35. Free travel on a pedal is set by adjusting the:

a. clutch linkage.
b. pressure plate.
c. rod pedal.
d. clutch pedal.

37.11.01.08

36. In a self-adjusting clutch, there is something different than other linkage clutches. What is it?

a. It has no pressure palte.
b. It has twice the pedal-free travel.
c. It has no pedal-free travel.
d. It has no throw-out lever.

37. At all times during driving, the throw-out bearing in a self-adjusting clutch is in contact with the:

a. pressure plate cover.
b. pressure plate levers.
c. clutch housing.
d. flywheel.

38. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?

a. coil springs.
b. mainspring.
c. throwout leverl.
d. diaphragm springs.

39. Clutch break-in is:

a. wearing the fuzz off a clutch plate.
b. adjusting the free play.
c. adjusting linkage.
d. aligning and realigning the pilot bearing.

40. Depressing the luctch pedal will do what to the throw-out bearing in a self-adjusting clutch?

a. Pulls the throw-out bearing away from the clutch levers.
b. Pushes the throw-out bearing towards the clutch levers.
c. Applies pressure to the pressure plate.
d. Engages the driven plate with the pressure plate.

37.11.02.01

41. Low gear in a three speed transmission has an approximate gear ratio of:

    a. 3 to 1
    b. 1 to 1
    c. 2 to 1
    d. 4 to 1

42. What is the gear ratio of a setup where the driving gear has 20 teeth and the driven gear has 50?

    a. 2.5 to 1
    b. 5 to 20
    c. 1 to 2.5
    d. 4 to 10

43. A torque multiplier is another name for a:

    a. transmission.
    b. crankshaft.
    c. supercharger.
    d. camshaft.

44. What is the function of an overrunning clutch in a overdrive transmission?

    a. eliminates the clutch.
    b. disengages the overdrive unit.
    c. rollers are wedged on the cam to eliminate power.
    d. restricts drive to one direction.

45. The type of gear which is the most superior of all the gears is the:

    a. face gear.
    b. spur gear.
    c. helical gear.
    d. crank gear.

37.11.02.02

46. One type of a transmission housing is made of:

    a. magnesium.
    b. pewter.
    c. cast iron.
    d. special steel.

47. Transmission gears are:

    a. formed while cold.
    b. formed while red hot.
    c. put into casting molds when warm.
    d. cut from a piece of cast iron.

37.11.02.02 (continued)

48. Generally in four speed transmission the gears are of what type?

- a. Spur.
- b. Helical.
- c. Backlash.
- d. Flank.

49. A typical transmission has how many shafts?

- a. at least 4
- b. 3
- c. 2
- d. 1

50. A transmission is shifted by means of:

- a. shifter forks.
- b. spring loaded steel balls.
- c. drive pins.
- d. shifter gates.

37.11.02.03

51. What shaft in the transmission drives the overdrive?

- a. input shaft.
- b. reverse adler shaft.
- c. output shaft.
- d. counter shaft.

52. The internal gear on an overdeive meshes with the:

- a. cluster gear.
- b. low gear.
- c. back gear.
- d. planetary pinions.

53. An overdrive is attached to:

- a. the rear of the transmission.
- b. the clutch plates.
- c. the sun gear.
- d. the front of the transmission.

54. An overdrive will give speed reduction for the engine of about what percent?

- a. 75%
- b. 30%
- c. 50%
- d. 60%

37.11.02.03 (continued)

55. In anoverdrive there is something that will cause free wheeling. That is the:

a. internal gear.
b. low gear.
c. roller clutch.
d. cluster gear.

37.11.02.04

56. Before working on a transmission, it is advisable to do what?

a. Clean transmission thoroughly.
b. Use a black light.
c. Test drive.
d. Read manual on assembly procedure.

57. To adjust excessive clutch pedal-free travel, you would:

a. adjust pedal linkage.
b. adjust shift linkage.
c. use a stronger return spring.
d. adjust clutch.

58. When transmission shifts hard in all gears, it could be:

a. wrong transmission lubricant.
b. defective input shaft bearing.
c. counter gear antilash plate worn or damaged.
d. worn or damaged input shaft bearing.

59. When a transmission is noisy in high gear, it could be because of:

a. shift linkage defective.
b. sticking shift rails.
c. defective output shaft bearing.
d. counter gear rear bearings worn or damaged.

60. When you have a problem such as overdrive that won't engage, it would be because:

a. the relay fust is blown.
b. the roller clutch cam is worn.
c. the kick-down switch is grounded.
d. there is insufficient back ring tension.

37.11.02.05

61. Before you can remove the transmission, you first must remove the:

a. pressure plate.
b. throw-out bearing.
c. drive shaft.
d. input shaft.

37.11.02.05 (continued)

62. What part(s) must be marked before removal?

- a. pressure plate.
- b. transmission bolts.
- c. throw-out bearing.
- d. u-joints.

63. Before removal of a transmission, what should you do for a safety measure?

- a. Disconnect battery.
- b. Remove clutch assembly.
- c. Remove drive shaft.
- d. Drain gas tank.

64. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:

- a. pressure plate.
- b. u-joint yoke.
- c. input shaft.
- d. throw-out bearing.

65. On some removals of transmissions it may be necessary to do what to the engine?

- a. set timing on the engine.
- b. loosen motor mounts.
- c. start engine.
- d. take engine out of car.

37.11.02.06

66. To remove the output or input shaft you must first remove the:

- a. pressure plate.
- b. counter gear.
- c. housing.
- d. low gear.

67. If a hammer needs to be used, what type should you use?

- a. a soft face hammer.
- b. none at all.
- c. not more than 3 lb. hammer.
- d. a small ballpeen hammer.

68. Where do you place a transmission when overhauling it?

- a. on a clean floor.
- b. in a clean parts tub.
- c. on a bench.
- d. on a swivel stand.

37.11.02.06 (continued)

69. When removing the synchronizer, it is important to keep what on each side of it to insure proper assembly?

    a. counter shaft.
    b. shifting forks.
    c. reverse idler gear.
    d. blocking rings.

70. What should you have on hand when dismantling a transmission?

    a. a steam cleaner.
    b. a person who is an expert on transmissions.
    c. an assortment of parts.
    d. a service manual.

37.11.02.07

71. It is possible to secure any degree of torque multiplication by:

    a. a heavier clutch.
    b. a larger engine.
    c. a larger torque amplifier.
    d. a set of various gears.

72. A rear seal can be removed:

    a. by heat, by expanding it.
    b. with a slide hammer.
    c. by shrinking it by using dry ice.
    d. by pressing it off.

73. When putting a front seal on a transmission, you have it facing:

    a. with lip facing the right of the housing.
    b. with lip out.
    c. with lip in.
    d. with lip facing the left of the housing.

74. To remove a rear oil seal, you can do so by:

    a. removing the throw-out bearing.
    b. taking the transmission out.
    c. removing the pressure plate.
    d. removing the drive shaft.

75. When overhauling a direct clutch and piston assembly, what do you do with the old seal?

    a. discard them.
    b. clean in gasoline.
    c. clean in carburetor cleaner.
    d. clean with clean rag.

37.11.02.08

76. If a gear has a blocking ring surface, it must be:

    a. smooth.
    b. rounded.
    c. uneven.
    d. rippled.

77. All snap ring grooves must have what kind of shoulders?

    a. square shoulders.
    b. stepped shoulders.
    c. bevelled shoulders.
    d. rounded shoulders.

78. The output shaft bearing surfaces should be smooth with:

    a. no evidence of galling.
    b. galling formations evident.
    c. excessive racking when gear is on.
    d. excessive play wehre gears are on.

79. The cluster gear is removed by removing the:

    a. anti-lash plate.
    b. reverse idler shaft.
    c. output shaft assembly.
    d. counter shaft.

80. One method used to secure a counter shaft is to:

    a. use a roll pin.
    b. use a bolt and nut.
    c. use a set screw.
    d. use an allen screw.

37.11.02.09

81. What fits over the inserts on a synchronizer hub?

    a. third-speed gear.
    b. blocking ring.
    c. insert springs.
    d. sleeve.

82. When assembling a synchronizer, you should lubricate with:

    a. light 10 weight oil.
    b. graphite.
    c. transmission lube.
    d. light weight grease.

87.11.02.09 (continued)

83. The hub has slats in it where what goes?

a. blocking ring.
b. sleeve.
c. inserts.
d. snap ring.

84. On the hub you should check for wear on the inner:

a. course grooves.
b. fine grooves.
c. splines.
d. cane surface.

85. How many inserts does a synchronizer hub have?

a. 1
b. 2
c. 3
d. 4

37.11.02.10

86. When pins pass through outer wall of the case, what should you do to prevent them from slipping out?

a. lead hole in.
b. glue pin to hole.
c. lubricate them.
d. stake them.

87. When the countershaft is in place, you should check end play with a:

a. depth gauge.
b. oscilloscope.
c. micrometer.
d. feeler gauge.

88. When the countershaft is in place, you should check end play with a:

a.
b.
c.
d.

89. New thrust washers, when assembling a transmission, will provide:

a. tight fit with no end play.
b. proper end play.
c. and act as an oil seal.
d. a backing mechanism for the shaft.

37.11.02.10 (continued)

90. When installing a new part in a transmission, it is important to try it in the transmission to be sure it:

a. has excessive clearance for heat expansion.
b. has excessive play.
c. fits properly.
d. wobbles on the shaft.

37.11.02.11

91. To hold a typical four-speed linkage in neutral while adjusting the linkage, you would use a(n):

a. pinion carrier.
b. retaining pin.
c. dust boat.
d. alignment pin.

92. If the linkage on a shift column has slotted adjustment holes, you:

a. just loosen adjustment nuts and leave shift rods connected.
b. take linkage completely off.
c. tighten adjusting nuts fully.
d. put shift levers in reverse.

93. To install the shift cover, you must place the transmission in:

a. low.
b. high.
c. reverse.
d. neutral.

94. When installing a shift fork cover, the shift forks must align with the:

a. countershaft.
b. pressure plate.
c. pilot bearing.
d. gear fork grooves.

95. When adjusting the linkage on a car, the transmission is:

a. in neutral.
b. out of the car.
c. just overhauled.
d. in high gear.

37.11.03.01

96. What unit in an automatic transmission eliminates the conventional clutch and pedal as used in the standard transmission?

a. torque converter.
b. stator.
c. fluid coupling.
d. governor valve.

37.11.03.01 (continued)

97. The converter vanes are shaped in what way?

    a. corrugated.
    b. straight.
    c. square.
    d. curved.

98. What is the principal difference between a fluid coupling and a torque converter?*

    a. the torque converter can't transmit engine torque but multiplies it.
    b. the fluid coupling can't transmit engine torque but can multiply it.
    c. the torque converter transmits engine torque but can't multiply it.
    d. the fluid coupling transmits all engine torque but can't multiply it.

99. A torus is:

    a. another name for a stator.
    b. half of a fluid coupling.
    c. another name for a torque converter.
    d. a complete fluid coupling.

100. The vanes in a fluid coupling are shaped how?

    a. boxed.
    b. straight.
    c. curved.
    d. corrugated.

37.11.03.02

101. For large torque increase what do the planetary pinions rotate around?

    a. the torque converter.
    b. the sun gear.
    c. the stator.
    d. the internal gear.

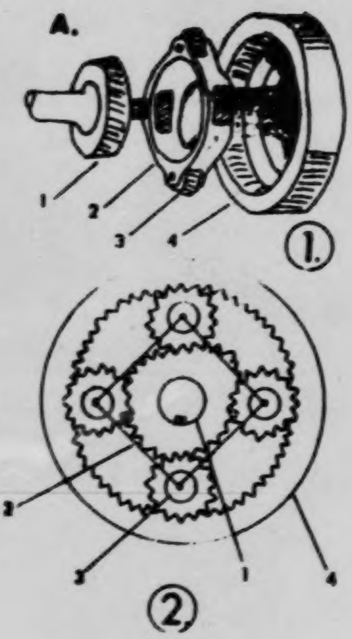
102. The planetary pinions rotate around the:

    a. stator.
    b. torque converter.
    c. sun gear.
    d. internal gear

*(From Auto Mechanics Fundamentals, Stockel, Goodheart-Wilcox, 1969, page 250 #10).

37.11.03.02 (continued)

A.



103. In diagram A, what is #2:

    - a. stator.
    - b. sun gear.
    - c. planetary pinions.
    - d. internal gear.

104. In diagram A, what is #4:

    - a. planetary pinions.
    - b. sun gears.
    - c. planetary carrier.
    - d. internal gear.

105. In diagram A*, what is #1:

    - a. internal gear.
    - b. planetary pinions.
    - c. sun gear.
    - d. stator.

37.11.03.03

106. What valve has to open just before the shifter valve does?

    - a. governor valve.
    - b. torus feed valve.
    - c. manual valve.
    - d. relief valve.

107. A servo operates a:

    - a. torque converter.
    - b. universal joint.
    - c. brake bank.
    - d. fluid coupling.

108. One type of oil pump used in an automatic transmission is the:

    - a. cooler type.
    - b. disc pump type.
    - c. stator type.
    - d. variable output type.

109. An apply piston is a servo is used to:

    - a. apply heavy pressure.
    - b. apply light pressure.
    - c. disengage the actuating lever.
    - d. release pressure.

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1969, page 231, Figure 12-27).

37.11.03.03 (continued)

110. In some servos you may have an accumulator piston used to:

a. apply heavy pressure.
b. apply light pressure.
c. release pressure.
d. disengage the actuating lever.

37.11.03.04

111. What type of modulator has a collapsing bellows in it?

a. engine vacuum.
b. altitude pressure type.
c. boost valve type.
d. check valve type.

112. A modulator consists of a container separated into two areas by a:

a. seal.
b. plate.
c. valve.
d. diaphragm.

113. A modulator uses what to operate?

a. engine oil pressure.
b. engine heat.
c. engine vacuum.
d. check valve.

114. One type of modulator works on the:

a. camshaft.
b. altitude air pressure.
c. check valve.
d. engine heat.

115. The modulator provides accurate control over the :

a. release valve.
b. throttle valve.
c. compensator valve.
d. pressure booster valve.

37.11.03.05

116. For normal duty transmissions, how many miles can you go before it is recommended to chain oil?

a. 24,000 miles.
b. 10,000 miles.
c. 50,000 miles.
d. 12,000 miles.

37.11.03.05 (continued)

117. Transmission fluid installed at the factory is generally:*

- a. a green color.
- b. a blue color.
- c. clear color.
- d. a red color.

118. Automatic transmissions require special fluid. It is identified by:

- a. BD-A
- b. AQ-TAF
- c. AQ-ATF
- d. AQ-A

119. You check transmission fluid level when the fluid is at:

- a. normal operating temperature.
- b. it doesn't matter what temperature.
- c. hot operating temperature.
- d. cold operating temperature.

120. To determine what type of leak you have under your car you can use a:

- a. flour spray.
- b. flourescent light.
- c. light coat of dust on pan.
- d. black light.

37.11.03.06

121. To check the adjustment of the downshift switch you use a:

- a. socket.
- b. gauge rod and test light.
- c. double square socket.
- d. torque wrench.

122. What do you use to adjust the tightening hand adjusting screw on an automatic transmission?

- a. a preset torque wrench.
- b. a hex bit.
- c. .250 in gauge block.
- d. throttle lever gauge.

*(From Auto Service and Repair, Stockel, Goodheart-Wilcox, 1969, pages 26-24, #12).

37.11.03.06 (continued)

123. A vacuum controlled primary throttle valve can be checked by:

a. applying a controlled vacuum unit to system.
b. applying a vacuum gauge to the system.
c. using a front servo gauge.
d. using a rear servo gauge.

124. To adjust a TV lever you must use what tool?

a. throttle lever bending tool.
b. rear servo gauge.
c. sliding t-bar.
d. sockets.

125. The engine mounts can effect what on the transmission?

a. shift linkage.
b. fluid coupling.
c. oil pump.
d. stator.

37.11.03.07

126. If the propeller shaft and transmission are not in sound condition, you would tow by:

a. disconnecting the drive shaft.
b. raising rear wheels.
c. putting transmission in neutral.
d. towing at a speed less than 25 mph.

127. The best way to start a car with an automatic transmission is by:

a. continually shifting transmission from reverse to low.
b. towing it forwards.
c. pushing it backward.
d. pushing it forward.

128. You should not tow a car with an automatic transmission when:

a. you can't raise the rear wheels.
b. you can't remove the drive shaft.
c. you can't put the transmission in drive.
d. there is no transmission fluid.

129. For some cars with automatic transmissions, the maximum distance that they can be towed is:

a. 25 miles.
b. 0 miles.
c. 10 miles.
d. 50 miles.

37.11.03.07 (continued)

130. Cars with torsion-level suspension system cannot be towed until:

   a. the car is in neutral.
   b. the linkage is disconnected.
   c. the drive shaft is disconnected.
   d. the levelizer control switch is off.

37.11.04.01

131. As the rear axle housing moves up and down in relation to the transmission, what unit allows the necessary flexing of the drive line?

   a. ball bearings.
   b. yoke.
   c. propeller shaft.
   d. transmission.

132. Wing type rollers are secured with:

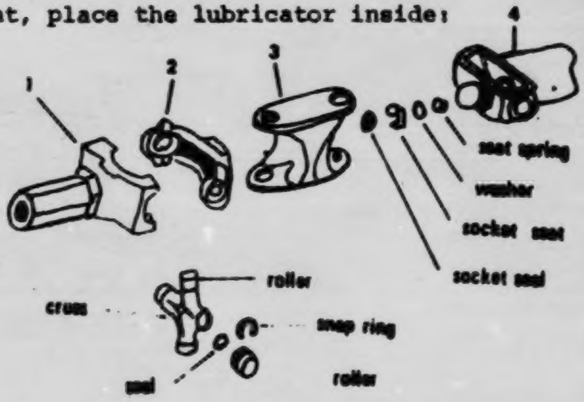
   a. snap ring.
   b. cap screws.
   c. center punching.
   d. u-bolts or clamps.

133. When lubricating a ball and trunnion joint, place the lubricator inside:

   a. no lubrication is needed.
   b. the dust boot.
   c. locating tang.
   d. the body raceway.

134. In the diagram*, what is #4?

   a. centering socket yoke.
   b. center yoke.
   c. socket support yoke.
   d. slip yoke.



135. To seat the roller against the snap rings, you strike the:

   a. seal.
   b. bearing.
   c. retainer.
   d. yoke.

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1969, pages 258 and 259, #s 2 and 4).

37.11.04.02

136. To check clearances on the propeller shaft, you use a(n):

a. feeler gauge.
b. dial indicator.
c. micrometer.
d. oscilloscope.

137. Angularity of the drive shaft can be checked by the use of a(n):

a. feeler gauge.
b. micrometer.
c. protractor.
d. oscilloscope.

138. To correct wrong angularity of a shaft, you would:

a. tighten transmission down tighter.
b. use shims.
c. tighten universal and yoke.
d. realign the differential drive pinion.

139. To prevent vibration, when drive shafts are made they should be:

a. lubricated.
b. balanced.
c. undercoated.
d. painted.

140. To maintain correct alignment of the gears, the bearings in a differential are made of:

a. aluminum-coated bearings.
b. hardened antifriction bearings.
c. spring steel.
d. bronze-covered bearings.

37.11.04.03

141. The recommended lubrication of rollers is:

a. sae 90 weight grease.
b. petroleum jelly.
c. light grease.
d. sae 140 weight grease.

142. If the center yoke is higher than the front and rear shafts, you can correct by using:

a. different rollers.
b. shims.
c. different differentials.
d. a different bearing support bracket assembly.

37.11.04.03 (continued)

143. When the propeller shaft is removed, you should do what with the rollers?

a. tape them on shaft.
b. lubricate them.
c. replace whenever the propeller shaft is removed.
d. wash them and place on clean rag.

144. The front shaft slip yoke engages the:

a. differential pinion gear.
b. rear end.
c. output shaft.
d. input shaft.

145. You can remove a roller with a vise and a:

a. rachet.
b. socket.
c. punch.
d. pair of pliers.

37.11.05.01

146. The ring gear is in direct contact with:

a. a pinion gear.
b. the transmission.
c. special head gear.
d. the propeller shaft.

147. How many units can a rear axle assembly be broken into?

a. four
b. two
c. three
d. five

148. The outer ends of the axles run in:

a. rubber seals.
b. bronze bushings.
c. roller or ball bearings.
d. brass bushings.

149. How many different types of axles are there?

a. five.
b. two.
c. three.
d. four.

37.11.05.01 (continued)

150. One type of housing that is used to house a differential is:

a. the strut.
b. the split.
c. the forked.
d. the spline.

37.11.05.02

151. The thrust member is spliced to the:

a. pinion shaft.
b. axle.
c. side gears.
d. differential case.

152. How many pinion shafts does a Chrysler sure-grip differential have?

a. three
b. one
c. four
d. two

153. How many clutch discs are spliced to the differential case?

a. tow
b. four
c. six.
d. three

154. How many clutch discs are spliced to the thrust member?

a. two
b. four
c. six
d. three

155. On a sure-grip differential what is forced to rotate with the differential case?

a. transmission.
b. rear end.
c. drive sprocket.
d. pinion shafts.

37.11.05.03

156. You would check for backlash with a:

a. dial indicator.
b. feeler gauge.
c. micrometer.
d. hydrometer.

37.11.05.03 (continued)

157. Excessive backlash should be corrected by:

    a. adjusting the pinion shafts adjusting nut.
    b. installing shim.
    c. adjusting the side-gear yoke.
    d. replacing defective parts.

158. When casing is completely stripped down and just before reassembly, you should:

    a. put linshaft back on the precise way you removed it.
    b. fill housing with lubrication.
    c. replace all oil seals.
    d. flush housing thoroughly.

159. To prevent damage to the oil seal when reinstalling, you:

    a. place a plug in axle hole.
    b. coat axle shaft with lubricant for 6".
    c. apply light heat to soften seal for installation.
    d. install a new seal.

160. Before removing the axle, you should measure:

    a. the rear ratio.
    b. the outside diameter of the axle.
    c. the power train assembly angle.
    d. end play.

37.11.05.04

161. To remove the bearing retainer, you use:

    a. a pliers.
    b. a punch.
    c. a puller.
    d. a chisel.

162. When you remove a bearing, you do so by:

    a. pressing it out.
    b. rapping it out.
    c. applying heat to case so you can slip bearing out.
    d. prying it out.

163. What else besides the bearing retainer has to be removed from the bearing before its removed?

    a. oil seal.
    b. pinion gear.
    c. inner bearings outer cup.
    d. pinion retainer.

37.11.05.04

164. The narrow ring of a bearing goes in, in what direction?

    a. toward the end of the axle shaft.
    b. it doesn't matter what way it goes in.
    c. toward the housing.
    d. toward the pinion gear.

165. To remove the axles, you should use a:

    a. press jack.
    b. spreader.
    c. pry bar.
    d. slide hammer type puller.

37.11.05.05

166. Before removing the differential case side bearing caps, make certain each cap and adjusting nut is:

    a. measured.
    b. marked.
    c. loosened.
    d. tightened.

167. When attaching the ring gear to the case flange, use:

    a. double-headed nuts.
    b. special fasteners for the purpose.
    c. fasteners with split back washers.
    d. any fasteners of the right size.

168. After you have the car jacked up and secured, you remove the:

    a. drive shaft.
    b. differential case.
    c. pinion drive gear.
    d. pinion shaft.

169. If the differential case is of the shim adjusted preload type, you remove it with:

    a. two pry bars.
    b. an easyout.
    c. a spreader.
    d. pliers.

170. After draining the housing, you remove:

    a. one axle shaft.
    b. the pinion bearing.
    c. both axles shafts.
    d. the axle housing.

37.11.05.06

171. Ring and pinion tooth contact pattern is checked by:

- a. a dial indicator.
- b. coating ring gear with red lead and oil mixture.
- c. a feeler gauge.
- d. applying grease to the pinion gear and rotating gear in a full circle.

172. The toe part of a ring gear is that part which:

- a. is centralized between the top and bottom of gear heel, is closer to the top.
- b. faces the inside of the gear.
- c. faces the outside of the gear.
- d. centralized between the top and the bottom of the gear.

173. What advantage does the spiral bevel gear have over the spur bevel?

- a. less tooth contact.
- b. the teeth are straight.
- c. it's quieter.
- d. center the tongue load on one tooth.

174. Why is a hypoid used?

- a. to facilitate in a non-slip rear end.
- b. to facilitate lowering the body of the car.
- c. to save on wear of the clutch plates.
- d. to facilitate raising the body of the car.

175. What is a hypoid gear setup as used in the differential?

- a. pinion gear engages ring gear above axle center line.
- b. pinion gear engages ring gear below the center line.
- c. a no-slip rear end.
- d. can clutch is synchronizm with the side gear.

37.11.05.07

176. To dry bearings, you:

- a. apply heat.
- b. let evaporate.
- c. use compressed air.
- d. use a clean rag.

177. What contains the carrier and pinion bearings?

- a. the bell housing.
- b. the clutch plates.
- c. the transmission.
- d. the differential carrier.

37.11.05.07 (continued)

178. To clean bearings, you wash them in:

- a. diesel fuel.
- b. gasoline.
- c. hot soapy water.
- d. cleaning solvent.

179. You install a side bearing by:

- a. driving it into position.
- b. lubricating and slipping into position.
- c. heating and slipping it into position.
- d. cooling and slipping it into position.

180. When replacing pinion gears and replacing a bearing cup, what do you use to remove the bearing cup?

- a. a hollow punch.
- b. a long punch.
- c. a puller.
- d. a needle vise pliers.

37.11.05.08

181. You check backlash in how many different spots around the gear?

- a. four
- b. three
- c. two
- d. one

182. Backlash must not vary more than:

- a. .101
- b. .005
- c. .002
- d. .020

183. You measure backlash with a:

- a. micrometer.
- b. dial indicator.
- c. feeler gauge.
- d. hydrometer.

37.11.05.08 (continued)

184. For each .001 change in backlash desired you transfer how many shims?

- a. .003
- b. .001
- c. .005
- d. .002

185. Why do you rotate a differential case a few times?

- a. to seal pinion gears.
- b. to seal bearings.
- c. to seal side gear.
- d. to adjust prelead.

UNIT TEST ANSWER SHEET

Occupational Area: Automotive
File Code: 37.11
Name: __________
Family Pay Number: __________ **Sex:** M F (Circle 1)

ANSWERS

0101	1.	B	0105	21.	C	0201	41.	A
	2.	A		22.	A		42.	A
	3.	B		23.	C		43.	A
	4.	C		24.	C		44.	B
	5.	C		25.	D		45.	C
0102	6.	C	0106	26.	D	0202	46.	C
	7.	A		27.	A		47.	B
	8.	A		28.	A		48.	B
	9.	A		29.	D		49.	A
	10.	C		30.	B		50.	A
0103	11.	A	0107	31.	C	0203	51.	C
	12.	A		32.	A		52.	D
	13.	A		33.	D		53.	A
	14.			34.	C		54.	B
	15.	A		35.	A		55.	C
0104	16.	D	0108	36.	C	0204	56.	C
	17.	D		37.	B		57.	A
	18.	C		38.	C		58.	A
	19.	D		39.	A		59.	C
	20.	C		40.	B		60.	A

UNIT TEST ANSWER SHEET

Occupational Area: Automotive
File Code: 37.11
Name:

ANSWERS

0205	61.	C
	62.	D
	63.	A
	64.	B
	65.	B
0206	66.	B
	67.	A
	68.	D
	69.	D
	70.	D
0207	71.	D
	72.	B
	73.	C
	74.	D
	75.	A
0208	76.	A
	77.	A
	78.	A
	79.	D
	80.	A
0209	81.	D
	82.	C
	83.	C
	84.	C
	85.	C
0210	86.	D
	87.	D
	88.	D
	89.	B
	90.	C
0211	91.	D
	92.	A
	93.	D
	94.	D
	95.	A
0301	96.	C
	97.	D
	98.	D
	99.	B
	100.	B
0302	101.	D
	102.	C
	103.	C
	104.	D
	105.	C
0303	106.	A
	107.	C
	108.	D
	109.	A
	110.	B
0304	111.	B
	112.	D
	113.	C
	114.	B
	115.	B
0305	116.	A
	117.	D
	118.	C
	119.	A
	120.	D

COURSE TEST ANSWER SHEET

Occupational Area: Automotive
File Code: 37.11
Name: ____________________ Sex: M F (Circle 1)
Family Pay Number: ____________________

ANSWERS

0306	121.	B
	122.	A
	123.	A
	124.	A
	125.	A
0307	126.	B
	127.	D
	128.	D
	129.	B
	130.	D
0401	131.	B
	132.	D
	133.	D
	134.	C
	135.	D
0402	136.	A
	137.	C
	138.	B
	139.	B
	140.	B
0403	141.	D
	142.	B
	143.	A
	144.	C
0404	145.	B
0501	146.	A
	147.	C
	148.	C
	149.	C
	150.	B
0502	151.	B
	152.	D
	153.	A
	154.	A
	155.	D
0503	156.	D
	157.	D
	158.	D
	159.	B
	160.	D
0504	161.	D
	162.	A
	163.	A
	164.	A
	165.	D
0505	166.	B
	167.	B
	168.	A
	169.	A
	170.	C
0506	171.	B
	172.	B
	173.	C
	174.	B
	175.	B
0507	176.	C
	177.	D
	178.	D
	179.	A
	180.	C
0508	181.	A
	182.	C
	183.	B
	184.	D
	185.	B

File Code: 37.11.01.00.B1-1

Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Experience Guide

UNIT: CLUTCHES

RATIONALE:

The techniques and procedures in this unit will enable you to diagnose and adjust clutches and replace components of the clutch.

PREREQUISITES:

None

OBJECTIVES:

Identify the components and proper operation of the clutch.

Perform clutch adjustment and component replacement.

RESOURCES:

Printed Materials

Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
A Time and Parts Manual.

Equipment

Automobile with clutch.
Automobile needing: throw out bearing replacement
pilot bushing
Tools, Basic Hand: Chisel and Punch Set
5/32" Pin Punch
3/16" Solid
Gauge, feeler (.002" - .025")
Hammer, ball peen
Hammer, plastic tip
Handle, speed
Hex Key Set
Pliers, diagonal cutting
Pliers, needle nose
Scraper, gasket
Screwdriver, standard (set)
Screwdriver, Phillips (set)

Principal Author(s): C. Schramm/W. Osland

Basic hand tools cont.

- Screw starter
- Socket Set (3/8" drive)
  - extension (3")
  - ratchet
- Socket Set (1/4" drive)
  - extension (3")
  - handle (6" flex)
  - ratchet
- Socket, spark plug
  - extension (6")
- Wrench, combination (set)
- Wrench, combination ignition (set)

Bushing puller -
Clutch aligning tool
Fender covers
Jack
Jack stands
Press
Replacement parts as needed
Slide hammer puller with adapter.

GENERAL INSTRUCTIONS:

This unit consists of eight Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

(1) Read the first assigned Learning Activity Package (LAP).
(2) Begin and complete the first assigned LAP.
(3) Take and score the LAP test.
(4) Turn in the LAP test answer sheet.
(5) Determine the reason for any missed items on the LAP test.
(6) Proceed to and complete the next assigned LAP in the unit.
(7) Complete all required LAPs for the unit by following steps 3 through 6.
(8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
(9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
(10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

.01 Fundamentals of Clutch
.02 Troubleshooting Clutches
.03 Replace Throw-Out Bearing
.04 Replace Clutch Pilot Bushing
.05 Pressure Plates
.06 Clutch Removal and Replace
.07 Adjusting Clutch Linkage
.08 Self-Adjusting Clutch

EVALUATION PROCEDURE:

When pretesting:

1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).

Student: ______________________ File Code: 37.11.01.00.B1-2

Date: ______________________ Date Published: 3/12/76

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UNIT PRETEST: CLUTCHES

37.11.01.01.

1. The clutch disc is constructed of:

   a. a high quality steel.
   b. pewter.
   c. bronze.
   d. cast iron.

2. The hub splines on a clutch are located.

   a. on the flywheel.
   b. on the clutch disc.
   c. on the pilot bushing.
   d. on the crankshaft.

3. What is used to provide pressure against the pressure plate?

   a. springs.
   b. torque from the engine.
   c. pressure plate.
   d. splined hub.

4. The pilot bearing of a clutch can either be made of ball bearings or:

   a. alloyed steel.
   b. bronze.
   c. aluminum.
   d. pewter.

5. The throw-out bearing sleeve is moved in and out by a:

   a. pressure plate spring.
   b. flywheel.
   c. clutch release lever.
   d. throw-out fork.

37.11.01.02.

6. When you have a warped clutch disc you can fix it by:

   a. adjusting linkage.
   b. grinding disc.
   c. install fork properly.
   d. replacing disc.

37.11.01.02. cont.

7. When your pilot bearing is worn, you can remedy it by:

   a. replacing it.
   b. installing new pressure plate.
   c. adjusting fingers.
   d. adjusting linkage.

8. When you have insufficient pedal free travel, you can fix it by:

   a. replacing disc.
   b. adjusting linkage.
   c. grind disc.
   d. align pilot bearing.

9. When you have broken a weak pressure plate spring, you can fix it by:

   a. replacing pressure plate.
   b. adjusting linkage.
   c. grinding clutch disc.
   d. clean clutch disc.

10.

37.11.01.03.

11. When installing a throw-out bearing just before you put the bearing on the shaft, you should:

   a. install pressure plate assembly.
   b. put the drive shaft on the transmission.
   c. lubricate it.
   d. align pilot bearing and pressure plate.

12. What kind of lubricant do you use on the throw-out bearing shaft?

   a. graphite.
   b. light oil.
   c. high temperature grease.
   d. none.

13. A new throw-out bearing is generally installed every:

   a. time you overhaul your clutch.
   b. year, or after 30,000 miles.
   c. six months.
   d. 25,000 miles.

37.11.01.03. cont.

14. To check a throw-out bearing for wear you:

    a. there is no inspection for a sealed throw-out bearing.
    b. test it with a dial indicator.
    c. test it with a feeler gauge.
    d. press against flat surface with pressure and revolve bearing.

15. One type of throw-out bearing is:

    a. hydraulic.
    b. bronze.
    c. aluminum.
    d. graphite.

37.11.01.04.

16. The pilot bushing is located:

    a. in the crankshaft.
    b. in the cluster gear.
    c. in the clutch disc.
    d. in the pressure plate.

17.

18. What part fits into the pilot bushing?

    a. throw-out bearing.
    b. input shaft.
    c. clutch disc.
    d. throw-out sleeve.

19. A defective pilot shaft bearing will make noise:

    a. all the time.
    b. when the clutch is disengaged half-way.
    c. when the clutch is fully engaged.
    d. when the clutch is disengaged fully.

20. You would lubricate a pilot bushing with:

    a. high temperature grease.
    b. graphite.
    c. heavy oil.
    d. light grease.

37.11.01.05.

21.

22. If you have scarring upon a pressure plate, you remove it by:

    a. polishing it.
    b. washing it in solvent.
    c. sanding lightly.
    d. scraping.

*23. Before removing the clutch cover fasteners, always:

    a. block the flywheel.
    b. check for disc warpage.
    c. prick punch the cover and flywheel.
    d. wipe them off.

*24. When installing the pressure plate assembly to the flywheel, always:

    a. tighten each fastener fully before starting on the next one.
    b. install the top bottom first.
    c. use a c-clamp to secure the unit.
    d. align the prick punch marks.

25. Pedal free travel is adjusted by:

    a. aligning the clutch housing.
    b. placing shims under the clutch cover.
    c. bending the pedal stop.
    d. adjusting the clutch linkage.

37.11.01.06.

26.

27. When removing the clutch, you should first disconnect the:

    a. flywheel.
    b. transmission.
    c. distributor.
    d. battery.

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p. 24-16, #s 3, 15, 22.)

37.11.01.06. cont.

28.

29. You disconnect the drive shaft by:

    a. taking off the transmission.
    b. taking off a universal joint.
    c. disconnecting linkage.
    d. taking the flywheel off.

30. In replacing a clutch, which one of the following is taken off first?

    a. pressure plate.
    b. universal joints.
    c. transmission.
    d. flywheel.

37.11.01.07.

31. The amount of travel for a clutch pedal before it comes into contact with the release levers is usually:

    a. 1 inch.
    b. 2 inches.
    c. 1/4 inch.
    d. 1/2 inch.

32. Free travel on a pedal is set by adjusting the:

    a. clutch pedal.
    b. pressure plate.
    c. pedal.
    d. clutch linkage.

33. On a hydraulic linkage if your free travel is not correct, you should first check the:

    a. throw-out lever.
    b. pressure plate.
    c. cylinder fluid level.
    d. lever-struts.

34.

37.11.01.07. cont.

35. How many different methods, in general, are used to actuate the throw-out fork?

    a. 2.
    b. 3.
    c. 4.
    d. 5.

37.11.01.08.

36. At all times during driving, the throw-out bearing in a self-adjusting clutch is in contact with the:

    a. clutch housing.
    b. pressure plate cover.
    c. flywheel.
    d. pressure plate levers.

37. In a self-adjusting clutch, pressure is applied to the throw-out fork by the:

    a. coil springs.
    b. lever struts.
    c. heavy mainspring.
    d. diaphragm spring.

38. Depressing the clutch pedal in a self-adjusting clutch will cause the throw-out bearing to:

    a. engage the driven plate with the pressure plate.
    b. pull away from the clutch levers.
    c. apply pressure to the pressure plate.
    d. push towards the clutch levers.

39. Clutch break-in is:

    a. aligning and realigning the pilot bearing.
    b. adjusting linkage.
    c. wearing off the fuzz off a clutch plate.
    d. adjusting the free play.

40. What applies pressure to an actuator in a self-adjusting clutch?

    a. pressure plate.
    b. coil springs.
    c. throw-out lever fork.
    d. a heavy mainspring.

UNIT TEST ANSWER SHEET

Occupational Area:
File Code: 37.11.01.00.B1-2
Name:
Family Pay Numbe
Sex M F (Circle 1)

ANSWERS

37.11.01.01	1.	A	37.11.01.05	21.	D	41.	
	2.	B		22.	C	42.	
	3.	A		23.	C	43.	
	4.	B		24.	D	44.	
	5.	D		25.	D	45.	
37.11.01.02	6.	D	37.11.01.06	26.	D	46.	
	7.	A		27.	D	47.	
	8.	B		28.	C	48.	
	9.	A		29.	B	49.	
	10.	A		30.	B	50.	
37.11.01.03	11.	C	37.11.01.07	31.	A	51.	
	12.	C		32.	D	52.	
	13.	A		33.	C	53.	
	14.	D		34.	C	54.	
	15.	D		35.	A	55.	
37.11.01.04	16.	A	37.11.01.08	36.	D	56.	
	17.	B		37.	C	57.	
	18.	B		38.	B	58.	
	19.	D		39.	C	59.	
	20.	A		40.	D	60.	

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Fundamentals of Clutch

OBJECTIVE:

Recognize the components and proper operation of the automotive clutch.

EVALUATION PROCEDURE:

80% correct on LAP study questions. 80% accuracy on LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Secure a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Read Chapter 9, "Engine Clutches," page 201 to page 209
3. On a separate sheet of paper, answer the questions on page 209.
4. Give your answer sheet to the instructor for evaluation.
5. Return the text to its proper place.
6. Take the LAP post test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.01.01.B1-2

Date: ____________________ Date Published: 11-10-77

Mountain-Plains Education &
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LAP TEST: FUNDAMENTALS OF CLUTCH

1. The pilot bearing of a clutch can be made either of ball bearings or:
   - a. bronze.
   - b. alloyed steel.
   - c. pewter.
   - d. aluminum.

2. The clutch pressure plate is generally made of:
   - a. cast iron.
   - b. pewter.
   - c. stainless steel.
   - d. aluminum.

3. The throw-out bearing sleeve is moved in and out by a:
   - a. flywheel.
   - b. throw-out fork.
   - c. clutch release fingers.
   - d. pressure plate spring.

4. What is used to provide pressure against the pressure plate?
   - a. torque from the engine.
   - b. splined hub.
   - c. springs.
   - d. pressure plate.

5. Of the following, which is not part of a conventional clutch?
   - a. pressure plate.
   - b. clutch sleeve.
   - c. clutch cover.
   - d. diaphragm spring.

6. The hub spline on a clutch is located:
   - a. on the crankshaft.
   - b. on the clutch disc.
   - c. on the pilot bushing.
   - d. on the flywheel.

7. The clutch housing bolts to the:

   a. engine.
   b. pressure plate.
   c. flywheel.
   d. crankshaft.

8. When mounting the transmission to the clutch housing, the transmission should be drawn up against the housing with the transmission mounting bolts.

   a. true
   b. false

9. The clutch side of a flywheel is:

   a. constructed of a starting gear ring.
   b. machined smooth.
   c. corrugated.
   d. mounted to the crankshaft.

10. The throw-out bearing is lubricated and should be serviced:

   a. when you have a lube job done on your car.
   b. twice a year.
   c. once a year.
   d. ordinarily would never be serviced.

LAP TEST ANSWER KEY: FUNDAMENTALS OF CLUTCH

1. A
2. A
3. B
4. C
5. B
6. B
7. A
8. B
9. B
10. D

File Code: 37.11.01.02.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Troubleshooting Clutches

OBJECTIVE:

Troubleshoot automotive clutches.

EVALUATION PROCEDURE:

The performance of the troubleshooting to be evaluated by the instructor in accordance with "Clutch Problem Diagnoses", pages 24-14, 24-15, 24-16 in Auto Service and Repair, Martin W. Stockel, Goodheart-Willcox Company, Inc., and the manufacturer's specifications.

80% accuracy on the LAP test.

RESOURCES:

Auto Service and Repair, Stockel.

Automobile with clutch problem

PROCEDURE:

1. Record the problem as explained by the customer.
   NOTE: Sometimes disassembly of the clutch component and careful examination of the parts is required to determine the exact cause of the problem. Refer to the repair manual for further aids on diagnosis.
2. Record what you believe the problem is.
3. Using the chart on pages 24-14 to 24-16 in Auto Service and Repair, record the cause of the problem and what work and parts are needed to correct the problem.
4. Give your paper to the instructor for evaluation.
5. Return the text and manual to proper places.
6. Take the LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.01.02.B1-2

Date: ____________________ Date Published: 3/10/76

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LAP TEST: TROUBLESHOOTING CLUTCHES

1. When the driver rides the clutch, you can best remedy it by:

   a. setting back clutch.
   b. instructing driver.
   c. putting heavy duty pressure plate springs in.
   d. setting up clutch.

2. When your pilot bearing is worn, you can remedy it by:

   a. installing new pressure plate.
   b. adjusting linkage.
   c. adjusting fingers.
   d. replacing it.

3. When your clutch disc is worn, you can fix it by:

   a. replacing pressure plate.
   b. replacing disc.
   c. grinding disc.
   d. adjusting throw-out bearing.

LAP TEST ANSWER KEY: TROUBLESHOOTING CLUTCHES

LAP .02

1. b
2. d
3. b

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Replacing Throw-Out Bearing

OBJECTIVE:

Recognize and follow the proper procedure to replace the automotive clutch throw-out bearing.

EVALUATION PROCEDURE:

80% accuracy required on the LAP test.

RESOURCES:

Auto Service and Repair, Stockel.

Automobile needing throw-out bearing replacement
Press
Throw-out bearing, new
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

NOTE: Review pages 24-8 and 24-9 in Auto Service and Repair.

1. Obtain the repair manual for the year and model you are working on.
2. Follow the procedure outlined in the manual and remove and replace the throw-out bearing.
   NOTE: If the bearing is the type that must be pressed into the sleeve, use a press. The use of a hammer may damage the bearing.
3. Ask the instructor to evaluate your work.
4. Take the LAP test.

Principal Author(s):

File Code: 37.10.01.04.B1-0

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Replacing Clutch Pilot Bushing

OBJECTIVE:

Recognize and follow the proper procedure to replace the automotive clutch pilot bushing.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering 8 out of 10 items on a multiple-choice test that is combined with "Replacing Throw-Out Bearing" LAP. The test will be taken after completing this LAP.

RESOURCES:

Auto Service and Repair, Stockel.

Bushing puller
Engine equipped with pilot bushing
Pilot bushing, new
Slide hammer bearing puller with adapter
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

NOTE: Review Chapter 24 in Auto Service and Repair.

1. Obtain the repair manual for the model and year engine you are working on.
2. Following the procedure in the manual, remove the pilot bushing.
   NOTE: A slide-hammer bearing puller, with an adapter to fit the size bushing you are working on, usually works very well.
3. Following the procedure in the manual, install the new pilot bushing.
4. Ask the instructor to evaluate your complete work.
5. Clean the work area, and clean and return tools, equipment and the manual.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.01.03. & .04 B1-2

Date: ____________________ Date Published: 3/10/76

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Glasgow AFB, Montana 59231

LAP TEST: REPLACE CLUTCH PILOT BUSHING/THROW-OUT BEARING

37.11.04.04.

1. What part fits into the pilot bushing?

   a. clutch disc
   b. input shaft
   c. throw-out bearing
   d. throw-out sleeve

2. The pilot bushing is located:

   a. in the crankshaft.
   b. in the cluster gear.
   c. in the pressure plate.
   d. in the clutch disc.

3. How many different types of pilot shaft bearings are there?

   a. 2
   b. 4
   c. 1
   d. 3

4. What is used to take out a pilot bushing?

   a. your fingers
   b. a small hammer
   c. a threaded puller
   d. a pry bar

5. A defective pilot shaft bearing will make noise:

   a. when the clutch is fully engaged.
   b. when the clutch is disengaged halfway.
   c. when the clutch is disengaged fully.
   d. it will make noise all the time.

37.11.01.03.

6. To check a throw-out bearing for wear, you:

   a. there is no inspection for a sealed throw-out bearing.
   b. press against flat surface with pressure and revolve bearing.
   c. test it with feeler gauge.
   d. test it with a dial indicator.

7. A new throw-out bearing is generally installed every:

   a. time you overhaul your clutch.
   b. six months.
   c. 2,500 miles.
   d. year, or after 30,000 miles.

8. To seat a throw-out bearing in a sleeve, you:

   a. press it in.
   b. use a puller to seat bearing.
   c. use a dial for set-up to seat bearing.
   d. tap it in with a hammer.

9. What kind of lubricant do you use on the throw-out bearing shaft?

   a. graphite
   b. high temperature grease
   c. none
   d. light oil

10.

LAP TEST ANSWER KEY: REPLACE CLUTCH PILOT BUSHING/THROW-OUT BEARING

LAP .04

1. b
2. a
3. a
4. c
5. c

LAP .03

6. b
7. a
8. a
9. b

[redacted]

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Learning Activity Package

Student: ______________

Date: ______________

PERFORMANCE ACTIVITY: Pressure Plates

OBJECTIVE:

Recognize the types of plates and causes for failure.

EVALUATION PROCEDURE:

80% correct on LAP study questions.

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Clutch Removal and Replacement" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Service and Repair, Stockel.

PROCEDURE:

1. Read Chapter 24, "Clutch Service," pages 24-1 to 24-16.
2. On a separate sheet of paper, answer the questions on pages 24-16 and 24-17.
3. Give your answer sheet to the instructor for evaluation.
4. Return the text to its proper place.
5. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

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File Code: 37.11.01.06.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Clutch Removal and Replacement

OBJECTIVE:

Recognize and follow the correct procedure to remove and replace the automotive clutch assembly.

EVALUATION PROCEDURE:

80% accuracy required on LAP test.

RESOURCES:

Auto Service and Repair, Stockel.

Clutch aligning tool
Clutch plate, new
Jack stands
Jacks or lift
Pressure plate, new
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

NOTE: Review Chapter 24 in Auto Service and Repair.

1. Raise car and secure on jack stands.
2. Find proper procedures for removing clutch in repair manual.
3. Follow procedures in the manual for removing and replacing the clutch.
4. Ask the instructor to evaluate your work.
5. Return tools to their proper places.
6. Clean your work area.
7. Take the LAP test.

NOTE: Use the clutch aligning tool during installation.

Principal Author(s): J. Anderson/C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.01.05.B1-2
37.11.01.06.B1-2

Date: ____________________ Date Published: 7-15-76

Revised: 8-09-78

LAP TEST: PRESSURE PLATE/CLUTCH REMOVAL AND REPLACEMENT

37.11.01.05

1. Before removing the clutch cover fasteners, always:

   a. wipe them off.
   b. prick punch the cover and flywheel.
   c. check for disc warpage.
   d. block the flywheel.

2. Excessive pedal free travel can cause:

   a. hard shifting.
   b. throw-out fork wear.
   c. fast throw-out bearing wear.
   d. clutch slipping.

3. The clutch friction disc is splined to the:

   a. crankshaft.
   b. transmission output shaft.
   c. clutch shaft.
   d. countershaft.

4. When the clutch is engaged, the friction disc is held against the flywheel by:

   a. the release levers.
   b. spring pressure.
   c. the throwout bearing.
   d. diaphragm-spring fingers.

5. Pedal free travel is adjusted by:

   a. aligning the clutch housing.
   b. bending the pedal stop.
   c. adjusting the clutch linkage.
   d. placing shims under the clutch cover.

37.11.01.06

6. The most likely cause of clutch slippage is:

   a. excessive clutch-spring pressure.
   b. insufficient clutch-spring pressure.
   c. excessive pedal lash.
   d. worn throwout bearing.

37.11.01.06 (continued)

7. You disconnect the drive shaft by:

   a. disconnecting linkage.
   b. taking off a universal joint.
   c. taking off the transmission.
   d. taking the flywheel off.

8. Free clutch pedal travel, or pedal lash, is adjusted by adjusting the:

   a. release levers.
   b. release bearing.
   c. clutch linkage.
   d. pressure plate.

9. What is used to align the clutch disc, pressure plate, and pilot bearing?

   a. clutch cushion
   b. your eye
   c. screwdriver
   d. clutch arbor.

10. In the diaphragm, spring clutch, the diaphragm not only provides the pressure that holds the friction against the flywheel but also:

   a. prevents engagement of the clutch when the pedal is released.
   b. actuates the throwout bearing.
   c. dampens the pulsations in clutch.
   d. functions as the release levers when the pedal is pushed down.

LAP TEST ANSWER KEY: PRESSURE PLATE/CLUTCH REMOVAL AND REPLACEMENT

LAP 05

1. B
2. A
3. C
4. B
5. C

LAP 06

6. B
7. B
8. C
9. D
10. D

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Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: Adjusting Clutch Linkage

OBJECTIVE:

Recognize and follow the proper procedure to adjust clutch pedal free play.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test.
"Troubleshooting Clutches" [illegible]

RESOURCES:

Auto Service and Repair, Stockel.

Automobile needing clutch adjustment
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

NOTE: Review pages 24-10 to 24-12 in Auto Service and Repair.

1. Obtain the manual for the year and model that you are working on.
2. Find the procedure in the manual for clutch adjustment.
   NOTE: Pedal free play allows the throw-out to move away from the pressure plate release fingers.
3. Adjust the pedal free play.
   NOTE: If snap rings or cotter keys are removed, replace with new ones. If hydraulic linkage is used, be sure to check for leaks.
4. Ask the instructor to evaluate your work.
5. Return manual and tools; clean work area.
6. Take LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.01.07.B1-2

Date: ____________________ Date Published: 3/10/76

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LAP TEST: ADJUSTING CLUTCH LINKAGE

1. How many different methods in general are used to actuate the throw-out fork?

   a. 3
   b. 4
   c. 5
   d. 2

2. The amount of travel for a clutch pedal before it comes into contact with the release levers is usually:

   a. 1/2 inch.
   b. 1 inch.
   c. 1/4 inch.
   d. 2 inches.

3. When adjusting linkage you check for:

   a. clutch temperature.
   b. clutch vibration.
   c. free play.
   d. pressure plate freeness.

File Code: 37.11.01.08.B1-C

Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Self-Adjusting Clutch

OBJECTIVE:

Recognize the operation of the automotive self-adjusting clutch.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test. [illegible]

RESOURCES:

Auto Serivce and Repair, Stockel.

PROCEDURE:

1. Secure a copy of Auto Service and Repair and a quiet place to study.
2. Read "Self-Adjusting Clutch" on page 24-12.
3. On a separate sheet of paper, write what makes the self-adjusting clutch different from other clutches.
4. On the same sheet of paper, write a description of how the self-adjusting clutch works.
5. Give your paper to the instructor for evaluation.
6. Return the text to its proper place.
7. Take the LAP test for this LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ **File Code:** 37.11.01.08.B1-2

Date: ______________________ **Date Published:** 3/10/76

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LAP TEST: SELF-ADJUSTING CLUTCH

1. Depressing the clutch pedal in a self-adjusting clutch will cause the throw-out bearing in a self-adjusting clutch to:

   a. pull away from the clutch levers.
   b. engage the driven plate with the pressure plate.
   c. apply pressure to the pressure plate.
   d. push towards the clutch levers.

2. Clutch break-in is:

   a. aligning and realigning the pilot bearing.
   b. adjusting linkage.
   c. adjusting the free play.
   d. wearing the fuzz off a clutch plate.

3. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?

   a. it has no pedal free travel.
   b. it has no pressure plate.
   c. it has twice the pedal free travel.
   d. it has no throw-out lever.

4. In a self-adjusting clutch, pressure is applied to the throw-out fork by:

   a. coil springs.
   b. a heavy mainspring.
   c. lever struts.
   d. a diaphragm spring.

LAP TEST ANSWER KEY: ADJUSTING CLUTCH LINKAGE/ SELF-ADJUSTING CLUTCH

LAP .07

1. d
2. b
3. c

LAP .08

4. a
5. d
6. a
7. b

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UNIT POST TEST: CLUTCHES (A)

37.11.01.01.

1. The clutch side of a flywheel is:

   a. cone shaped.
   b. corrugated.
   c. machined smooth.
   d. knurled.

2. Release levers in a clutch are in what group?

   a. spindal hub assembly.
   b. starter ring gear assembly.
   c. flywheel assembly.
   d. pressure plate assembly.

3. The inner hub of a clutch disc and the thin outer disc are fastened together to allow a certain radial movement between them. This movement is controlled by the:

   a. stop pins.
   b. pressure plate spring.
   c. crankshaft splines.
   d. coil spring.

4. The hub splines engage:

   a. splines on the camshaft.
   b. splines on the clutch disc.
   c. splines on the transmission input shaft.
   d. splines on the crankshaft.

5. The throw-out bearing is lubricated and should be serviced:

   a. ordinarily would never be serviced.
   b. when you have a lube job done on your car.
   c. twice a year.
   d. once a year.

37.11.01.02.

6. When the driver rides the clutch, you can remedy it by:

   a. instructing driver.
   b. setting up clutch.
   c. setting back clutch.
   d. putting heavy duty pressure plate springs in.

37.11.01.02. cont.

7.

8. When you have broken a weak pressure plate spring, you can fix it by:

   a. adjusting linkage.
   b. grinding clutch disc.
   c. cleaning clutch disc.
   d. replacing pressure plate.

9. When you have a warped clutch disc, you can fix it by:

   a. installing fork properly.
   b. grinding disc.
   c. replacing disc.
   d. adjusting linkage.

10. When the pilot bearing becomes worn, it should be fixed by:

   a. replacement.
   b. adjusting the linkage.
   c. adjusting the fingers.
   d. installing a new pressure plate.

37.11.01.03.

11.

12. It is a good safety practice before you start working on a throw-out bearing to:

   a. be sure car is in gear.
   b. drain transmission.
   c. disconnect battery.
   d. have the correct tools available.

13. Before you can remove the throw-out bearing, you need to first remove the:

   a. clutch plate.
   b. pressure plate.
   c. throw-out fork.
   d. transmission.

37.11.01.03. cont.

14. To seat a throw-out bearing in a sleeve, you:

    a. use a puller to seat bearing.
    b. tap it in with a hammer.
    c. press it in.
    d. use a dial fork set-up to seat bearing.

15. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:

    a. transmission.
    b. pressure plate.
    c. inspection pan.
    d. clutch pressure plate.

37.11.01.04.

16. How many different types of pilot shaft bearings are there?

    a. 2.
    b. 1.
    c. 3.
    d. 4.

17. You would lubricate a pilot bushing with:

    a. graphite.
    b. light grease.
    c. heavy oil.
    d. high temperature grease.

18. What is used to take out a pilot bushing?

    a. a threaded puller.
    b. your fingers.
    c. a pry bar.
    d. a small hammer.

19. The pilot bushing is located:

    a. in the clutch disc.
    b. in the crankshaft.
    c. in the pressure plate.
    d. in the cluster gear.

20. What part fits into the pilot bushing?

    a. input shaft.
    b. throw-out sleeve.
    c. throw-out bearing.
    d. clutch disc.

37.11.01.05.

*21. When installing the pressure plate assembly to the flywheel, always:

a. install the top bottom first.
b. align the prick punch marks.
c. use a C-clamp to secure the unit.
d. tighten each fastener fully before starting on the next one.

22. Pedal free travel is adjusted by:

a. placing shims under the clutch cover.
b. aligning the clutch housing.
c. adjusting the clutch linkage.
d. bending the pedal stop.

*23.

24. Excessive pedal free travel can cause:

a. fast throw-out bearing wear.
b. throw-out fork wear.
c. hard shifting.
d. clutch slipping.

25.

37.11.01.06.

26. What is used to align the clutch disc, pressure plate pilot bearing?

a. screwdriver.
b. clutch arbor.
c. your eye.
d. clutch cushion.

27.

---

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p. 24-16, #s 3, 15, 22.)

37.11.01.06. cont.

28.

29. When replacing a clutch, you remove the throw-out bearing by:

    a. tapping it off lightly with soft-face hammer.
    b. screwing it out by hand.
    c. pressing it off the shaft.
    d. lifting it out by hand.

30.

37.11.01.07.

31.

32. One type of procedure used to activate the throw-out fork is:

    a. electric.
    b. hydraulic.
    c. torque procedure.
    d. chain link.

33. On a hydraulic linkage, if your free travel is not correct, you should first check the:

    a. lever-struts.
    b. cylinder fluid level.
    c. throw-out lever.
    d. pressure plate.

34.

37.11.01.07.

35. When adjusting linkage, you check for:

    a. pressure plate freeness.
    b. clutch vibration.
    c. clutch temperature.
    d. free play.

37.11.01.08.

36. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?

    a. it has no pressure plate.
    b. it has twice the pedal free travel.
    c. it has no pedal free travel.
    d. it has no throw-out lever.

37. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?

    a. diaphragm springs.
    b. throw-out lever.
    c. coil springs.
    d. second spring.

38. In a self-adjusting clutch, pressure is applied to the throw-out fork by:

    a. lever-struts.
    b. coil springs.
    c. a diaphragm spring.
    d. a heavy mainspring.

39. Pressure is applied to an actuator in a self-adjusting clutch by:

    a. a heavy mainspring.
    b. coil springs.
    c. a throw-out lever fork.
    d. a pressure plate.

40. Clutch break-in is:

    a. wearing the fuzz off a clutch plate.
    b. adjusting linkage.
    c. aligning and realigning the pilot bearing.
    d. adjusting the free play.

UNIT POST TEST ANSWER KEY (A)

Occupational Area: ______________
File Code: 37.11.01.00.C1-2
Name: ______________
Family Pay Number: ______________ Sex M F (Circle 1)

ANSWERS

37.11.01.01	1. C ____	37.11.01.05	21. B ____	41. ____
	2. D ____		22. C ____	42. ____
	3. A ____		[redacted] ____	43. ____
	4. C ____		24. C ____	44. ____
	5. A ____		[redacted] ____	45. ____
37.11.01.02	6. A ____	37.11.01.06	26. B ____	46. ____
	7. C ____		[redacted] ____	47. ____
	8. D ____		[redacted] ____	48. ____
	9. C ____		29. D ____	49. ____
	10. A ____		[redacted] ____	50. ____
37.11.01.03	[redacted] ____	37.11.01.07	[redacted] ____	51. ____
	12. C ____		32. B ____	52. ____
	13. D ____		33 B ____	53. ____
	14. C ____		[redacted] ____	54. ____
	15. C ____		35 D ____	55. ____
37.11.01.04	16. A ____	37.11.01.08	36. C ____	56. ____
	17. D ____		37. B ____	57. ____
	18. A ____		38. D ____	58. ____
	19. B ____		39. A ____	59. ____
	20. A ____		40. A ____	60. ____

Student: ____________________ File Code: 37.11.01.00.C1-2 (B)

Date: ____________________ Date Published: 6/8/77

UNIT POST TEST: CLUTCHES (B)

37.11.01.01

1. The throw-out bearing is lubricated and should be serviced:

   a. ordinarily would never be serviced
   b. when you have a lube job done on your car
   c. twice a year
   d. once a year

2. The hub splines engage:

   a. splines on the camshaft
   b. splines on the clutch disc
   c. splines on the transmission input shaft
   d. splines on the crankshaft

3. The inner hub of a clutch disc and the thin outer disc are fastened together to allow a certain radial movement between them. This movement is controlled by the:

   a. stop pins
   b. pressure plate spring
   c. crankshaft splines
   d. coil spring

4. Release levers in a clutch are in what group?

   a. spindal hub assembly
   b. starter ring gear assembly
   c. flywheel assembly
   d. pressure plate assembly

5. The clutch side of a flywheel is:

   a. cone shaped
   b. corrugated
   c. machined smooth
   d. knurled

37.11.01.02

6. When the pilot bearing becomes worn, it should be fixed by:

   a. replacement
   b. adjusting the linkage
   c. adjusting the fingers
   d. installing a new pressure plate

37.11.01.02 cont.

7. When you have a warped clutch disc, you can fix it by:

   a. installing fork properly
   b. grinding disc
   c. replacing disc
   d. adjusting linkage

8. When you have broken a weak pressure plate spring, you can fix it by:

   a. adjusting linkage
   b. grinding clutch disc
   c. cleaning clutch disc
   d. replacing pressure plate

9. When the driver rides the clutch, you can remedy it by:

   a. instructing driver
   b. setting up clutch
   c. setting back clutch
   d. putting heavy duty pressure plate springs in

37.11.01.03

10. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:

    a. transmission
    b. pressure plate
    c. inspection pan
    d. clutch pressure plate

11. To seat a throw-out bearing in a sleeve, you:

    a. use a puller to seat bearing
    b. tap it in with a hammer
    c. press it in
    d. use a dial fork set-up to seat bearing

12. Before you can remove the throw-out bearing, you need to first remove the:

    a. clutch plate
    b. pressure plate
    c. throw-out fork
    d. transmission

13. It is a good safety practice before you start working on a throw-out bearing to:

    a. be sure car is in gear
    b. drain transmission
    c. disconnect battery
    d. have the correct tools available

37.11.01.04

14. What part fits into the pilot bushing?

    a. input shaft
    b. throw-out sleeve
    c. throw-out bearing
    d. clutch disc

15. The pilot bushing is located:

    a. in the clutch disc
    b. in the crankshaft
    c. in the pressure plate
    d. in the cluster gear

16. What is used to take out a pilot bushing?

    a. a threaded puller
    b. your fingers
    c. a pry bar
    d. a small hammer

17. You would lubricate a pilot bushing with:

    a. graphite
    b. light grease
    c. heavy oil
    d. high temperature grease

18. How many different types of pilot shaft bearings are there?

    a. 2
    b. 1
    c. 3
    d. 4

37.11.01.05

19. Excessive pedal free travel can cause:

    a. fast throw-out bearing wear
    b. throw-out fork wear
    c. hard shifting
    d. clutch slipping

20. Pedal free travel is adjusted by:

    a. placing shims under the clutch cover
    b. aligning the clutch housing
    c. adjusting the clutch linkage
    d. bending the pedal stop

37.11.01.05 cont.

21. *When installing the pressure plate assembly to the flywheel, always:

    a. install the top bottom first
    b. align the prick punch marks
    c. use a C-clamp to secure the unit
    d. tighten each fastener fully before starting on the next one

37.11.01.06

22. When replacing a clutch, you remove the throw-out bearing by:

    a. tapping it off lightly with soft-face hammer
    b. screwing it out by hand
    c. pressing it off the shaft
    d. lifting it out by hand

23. What is used to align the clutch disc, pressure plate pilot bearing?

    a. screwdriver
    b. clutch arbor
    c. your eye
    d. clutch cushion

37.11.01.07

24. When adjusting linkage, you check for:

    a. pressure plate freeness
    b. clutch vibration
    c. clutch temperature
    d. free play

25. On a hydraulic linkage, if your free travel is not correct, you should first check the:

    a. lever-struts
    b. cylinder fluid level
    c. throw-out lever
    d. pressure plate

26. One type of procedure used to activate the throw-out fork is:

    a. electric
    b. hydraulic
    c. torque procedure
    d. chain link

37.11.01.08

27. Clutch break-in is:

    a. wearing the fuzz off a clutch plate
    b. adjusting linkage
    c. aligning and realigning the pilot bearing
    d. adjusting the free play

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p.

37.11.01.08 cont.

28. Pressure is applied to an actuator in a self-adjusting clutch by:

a. heavy mainspring
b. coil springs
c. a throw-out lever fork
d. a pressure plate

29. In a self-adjusting clutch, pressure is applied to the throw-out fork by:

a. lever-struts
[✓ b.] coil springs
c. a diaphragm spring
d. a heavy mainspring

30. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?

a. diaphragm springs
b. throw-out lever
c. coil springs
d. second spring

31. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?

a. it has no pressure plate
b. it has twice the pedal free travel
c. it has no pedal free travel
d. it has no throw-out lever

UNIT POST TEST ANSWER KEY: CLUTCHES (B)

1. A
2. C
3. A
4. D
5. C
6. A
7. C
8. D
9. A
10. C
11. C
12. D
13. C
14. A
15. B
16. A
17. D
18. A
19. C
20. C
21. B
22. D
23. B
24. D
25. B
26. B
27. A
28. A
29. D
30. B
31. C

Student: ____________________ File Code: 37.11.01.00.C1-2 (C)

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UNIT POST TEST: CLUTCHES (C)

37.11.01.01

1. Release levers in a clutch are in what group?

   a. spindal hub assembly
   b. starter ring gear assembly
   c. flywheel assembly
   d. pressure plate assembly

2. The inner hub of a clutch disc and the thi. outer disc are fastened together to allow a certain radial movement between them. This movement is controlled by the:

   a. stop pins
   b. pressure plate spring
   c. crankshaft splines
   d. coil springs

3. The throw-out bearing is lubricated and should be serviced:

   a. ordinarily would never be serviced
   b. when you have a lube job done on your car
   c. twice a year
   d. once a year

4. The clutch side of a flywheel is:

   a. cone shaped
   b. corrugated
   c. machined smooth
   d. knurled

5. The hub splines engage:

   a. splines on the camshaft
   b. splines on the clutch disc
   c. splines on the transmission input shaft
   d. splines on the crankshaft

37.11.01.02

6. When the driver rides the clutch, you can remedy it by:

   a. instructing driver
   b. setting up clutch
   c. setting back clutch
   d. putting heavy duty pressure plate springs in

37.11.01.02 cont.

7. When the pilot bearing becomes worn, it should be fixed by:

   a. replacement
   b. adjusting the linkage
   c. adjusting the fingers
   d. installing a new pressure plate

8. When you have broken a weak pressure plate spring, you can fix it by:

   a. adjusting linkage
   b. grinding clutch disc
   c. cleaning clutch disc
   d. replacing pressure plate

9. When you have a warped clutch disc, you can fix it by:

   a. installing fork properly
   b. grinding disc
   c. replacing disc
   d. adjusting linkage

37.11.02.03

10. Before you can remove the throw-out bearing, you need to first remove the:

    a. clutch plate
    b. pressure plate
    c. throw-out fork
    d. transmission

11. To be able to see the throw-out bearing when it is on the throw-out fork, you need to take off the:

    a. transmission
    b. pressure plate
    c. inspection pan
    d. clutch pressure plate

12. It is a good safety practice before you start working on a throw-out bearing to:

    a. be sure car is in gear
    b. drain transmission
    c. disconnect battery
    d. have the correct tools available

13. To seat a throw-out bearing in a sleeve, you:

    a. use a puller to seat bearing
    b. tap it in with a hammer
    c. press it in
    d. use a dial fork set-up to seat bearing

37.11.01.04

14. How many different types of pilot shaft bearings are there?

    a. 2
    b. 1
    c. 3
    d. 4

15. What part fits into the pilot bushing?

    a. input shaft
    b. throw-out sleeve
    c. throw-out bearing
    d. clutch disc

16. The pilot bushing is located:

    a. in the clutch disc
    b. in the crankshaft
    c. in the pressure plate
    d. in the cluster gear

17. You would lubricate a pilot bushing with:

    a. graphite
    b. light grease
    c. heavy oil
    d. high temperature grease

18. What is used to take out a pilot bushing?

    a. a threaded puller
    b. your fingers
    c. a pry bar
    d. a small hammer

37.11.01.05

19. When installing the pressure plate assembly to the flywheel, always:

    a. install the top bottom first
    b. align the prick punch marks
    c. use a C-clamp to secure the unit
    d. tighten each fastener fully before starting on the next one

20. Excessive pedal free travel can cause:

    a. fast throw-out bearing wear
    b. throw-out fork wear
    c. hard shifting
    d. clutch slipping

*(Adapted from Auto Service and Repair, Stockel, Goodheart-Wilcox, 1975, p. 24-16, #s 3,15,22.)

37.11.01.05 cont.

21. Pedal free travel is adjusted by:

a. placing shims under the clutch cover
b. aligning the clutch housing
c. adjusting the clutch linkage
d. bending the pedal stop

37.11.01.06

22. What is used to align the clutch disc, pressure plate pilot bearing?

a. screwdriver
b. clutch arbor
c. your eye
d. clutch cushion

23. When replacing a clutch, you remove the throw-out bearing by:

a. tapping it off lightly with soft-face hammer
b. screwing it out by hand
c. pressing it off the shaft
d. lifting it out by hand

37.11.01.07

24. On a hydraulic linkage, if your free travel is not correct, you should first check the:

a. lever-struts
b. cylinder fluid level
c. throw-out lever
d. pressure plate

25. When adjusting linkage, you check for:

a. pressure plate freeness
b. clutch vibration
c. clutch temperature
d. free play

26. One type of procedure used to activate the throw-out fork is:

a. electric
b. hydraulic
c. torque procedure
d. chain link

37.11.01.08

27. In a self-adjusting clutch, there is something different than in other linkage clutches. What is it?

a. it has no pressure plate
b. it has twice the pedal free travel
c. it has no pedal free travel
d. it has no throw-out lever

37.11.01.08 cont.

28. Clutch break-in is:

    a. wearing the fuzz off a clutch plate
    b. adjusting linkage
    c. aligning and realigning the pilot bearing
    d. adjusting the free play

29. Pressure is applied to an actuator in a self-adjusting clutch by:

    a. a heavy mainspring
    b. coil springs
    c. a throw-out lever fork
    d. a pressure plate

30. In a self-adjusting clutch, what pushes the throw-out bearing against the pressure plate levers?

    a. diaphragm springs
    b. throw-out levar
    c. coil springs
    d. second spring

31. In a self-adjusting clutch, pressure is applied to the throw-out fork by:

    a. lever-struts
    b. coil springs
    c. a diaphragm spring
    d. a heavy mainspring

UNIT POST TEST ANSWER KEY: CLUTCHES (C)

1. D
2. A
3. A
4. C
5. C
6. A
7. A
8. D
9. C
10/ D
11. C
12. C
13. C
14. A
15. A
16. B
17. D
18. A
19. B
20. C
21. C
22. B
23. D
24. B
25. D
26. B
27. C
28. A
29. A
30. B
31. D

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Glasgow AFB, Montana 59231

Student: ____________________ File Code: 37.11.01.00.B1-5

Date: ____________________ Date Published: 3/10/76

Family Pay Number: __________ Sex: M F (Circle 1)

UNIT PERFORMANCE TEST: CLUTCHES

OBJECTIVE 1:

Trouble shoot clutch.

OBJECTIVE 2:

Remove and repair clutch

OBJECTIVE 3:

Replace and adjust clutch.

TASK:

The student will be assigned a vehicle with a clutch and he must troubleshoot, remove, repair, replace, and adjust the clutch assembly.

ASSIGNMENT:

CONDITIONS:

The student may use only those materials provided for the test and must perform the test in the auto shop.

RESOURCES:

Auto with clutch
Repair manual
Time and parts guide
New clutch parts, if needed

RESOURCES: (Continued)

Jack
Jack stands
Fender covers
Pilot shaft
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

Student: ____________________ **File Code:** 37.11.08.00.B1-5

Date: ____________________ **Date Published:** 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Family Pay Number:___________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

CRITERION

	Met	Not Met
Objective 1:		
1. Troubleshoot clutch.		
Criterion: Compare to manufacturer's operation and specifications.		
Objective 2:		
2. Remove and repair clutch.		
Criterion: Safely remove clutch assembly without damage		
to transmission; compare all parts to manufacturer's		
specifications.		
Objective 3:		
3. Replace and adjust clutch assembly.		
Criterion: Must operate as per manufacturer's specifications.		
4. Complete test in allotted time.		
Criterion: Must meet flat rate on assigned vehicle.		
Student must complete 3 of 4 line items to pass test.		

File Code: 37.11.02.00.B1-1

Date Published: 3/10/76

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Learning Experience Guide

UNIT: STANDARD TRANSMISSIONS

RATIONALE:

The fundamentals in this unit will familiarize one with the components and functions of standard transmissions and enable one to diagnose and overhaul standard transmissions.

PREREQUISITES:

None

OBJECTIVE:

Identify the components and proper operations of standard transmissions and use the proper procedure for troubleshooting and overhaul of the standard transmission.

RESOURCES:

Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Motor's Auto Repair Manual. Motor. The Hearst Corporation. 1972 or equivalent.

Automobile with standard transmission.
Bearings and seals.
Gaskets.
Gasket cement.
Grease.
Jacks.
Jack stands.
Puller.
Replacement parts as needed.
Sealant.
Shift cover gasket.
Snap rings.
Snap ring pliers
Synchonrizers

Principal Author(s): C. Schramm/W. Osland

RESOURCES (CONT.)

Tools, Basic Hand:

- Chisel and Punch Set
  - 5/32" Pin Punch
  - 3/16" Solid
- Gauge, feeler (.002" - .025")
- Hammer, ball peen
- Hammer, plastic tip
- Handle, speed
- Hex Key Set
- Pliers, diagonal cutting
- Pliers, needle nose
- Scraper, gasket
- Screwdriver, standard (set)
- Screwdriver, Phillips (set)
- Screw starter
- Socket Set (3/8" drive)
  - extension (3")
  - ratchet
- Socket Set (1/4" drive)
  - extension (3")
  - handle (6" flex)
  - ratchet
- Socket, spark plug
  - extension (6")
- Wrench, combination (set)
- Wrench, combination ignition (set)

Transmission lubricant and oil.

GENERAL INSTRUCTIONS:

This unit consists of eleven Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

(1) Read the first assigned Learning Activity Package (LAP).
(2) Begin and complete the first assigned LAP.
(3) Take and score the LAP test.
(4) Turn in the LAP test answer sheet.
(5) Determine the reason for any missed items on the LAP test.
(6) Proceed to and complete the next assigned LAP in the unit.
(7) Complete all required LAPs for the unit by following steps 3 through 6.
(8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
(9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
(10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

.01 Fundamentals of 3-Apeed Standard
.02 Fundamentals of 4-Speed Standard
.03 Fundamentals of Overdrive
.04 Troubleshooting Standard Transmission
.05 Transmission Removal
.06 Transmission Disassembly
.07 Bearings and Seals
.08 Gears and Shafts
.09 Sychronizers
.10 Transmission Assembly
.11 Shift Forks and Linkage

EVALUATION PROCEDURE:

When pretesting:

1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).

Student: ______________________ File Code: 37.11.02.00.B1-2

Date: ______________________ Date Published: 3/12/76

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UNIT PRETEST: STANDARD TRANSMISSIONS

37.11.02.01.

1. What is the function of an overrunning clutch in a overdrive transmission?

   a. disengages the overdrive unit.
   b. eliminates the clutch.
   c. rollers are wedges on the cam to eliminate power.
   d. restricts drive to one direction.

2. Which central device on an overdrive transmission operates the backing pawl?

   a. gorrenoe.
   b. solenoid.
   c. relay.
   d. reverse drum.

3. The gear that runs the noisiest of all gear types is the:

   a. helical gear.
   b. face gear.
   c. spur gear.
   d. flank gear.

4. Low gear in a three-speed transmission has an approximate gear ratio of:

   a. 1 to 1.
   b. 2 to 1.
   c. 3 to 1.
   d. 4 to 1.

5. When a manual transmission is shifted into reverse, what extra gear is interposed to reverse the direction of the main shaft?

   a. reverse synchromesh ring.
   b. countershaft gear.
   c. reverse idler gear.
   d. low and reverse sliding gear.

37.11.02.02.

6. There are various types of synchronizer devices, but they all have one thing in common; that is:

   a. they all mesh 4 forward gears and reverse.
   b. they all use a blocking ring that precedes the clutch hub.
   c. they are all mounted on the counter shaft.
   d. they are all mounted on the reverse idler shaft.

37.11.02.02. cont.

7. A transmission is shifted by means of:

   a. shifter gates.
   b. drive pins.
   c. spring loaded steel balls.
   d. shifter forks.

8. One type of transmission housing is made of:

   a. special steel.
   b. magnesium.
   c. cast iron.
   d. bronze.

9. Transmission gears are made of high quality:

   a. steel.
   b. cast iron.
   c. platinum.
   d. fiber compound.

10. Transmission gears are formed while they are:

    a. cold.
    b. red hot.
    c. cut from a piece of cast iron.
    d. put into casting molds when warm.

37.11.02.03.

11. What shaft in the transmission drives the overdrive?

    a. counter shaft.
    b. input shaft.
    c. reverse idler shaft.
    d. output shaft.

12. The planetary pinions revolve around the:

    a. back gear.
    b. sun gear.
    c. shift fork.
    d. ring gear.

13. At about what speed will the overdrive kick in or become operative?

    a. 20 mph.
    b. 15 mph.
    c. 10 mph.
    d. 30 mph.

14. An overdrive is attached:

    a. to the rear of the transmission.
    b. in the transmission.
    c. to the side of the transmission.
    d. to the top of the transmission.

37.11.02.03. cont.

15. The internal gear on an overdrive meshes with the:

    a. back gear.
    b. low gear.
    c. planet pinions.
    d. cluster gear.

37.11.02.04.

16. After you have compiled the data on what is wrong with the transmission, you:

    a. record a work order.
    b. mark on a piece of paper.
    c. make a mental note of it.
    d. take transmission out of car.

17. To get a basic idea of what is wrong with the transmission, before you drive the car you can:

    a. raise car and visually inspect.
    b. raise car and use block light.
    c. ask owner what it is doing.
    d. raise car and wash.

18. When you have a problem such as the overdrive won't engage, it could be because:

    a. the relay fuse is blown.
    b. the kick-down switch is grounded.
    c. the roller clutch cam is worn.
    d. there is insufficient back ring tension.

19. To adjust excessive clutch pedal free travel, you would:

    a. adjust clutch.
    b. adjust shift linkage.
    c. use a stronger return spring.
    d. adjust pedal linkage.

20. If a standard transmission is hard to shift in all gears, a likely cause is:

    a. use of the wrong lubricant.
    b. a worn or damaged input shaft bearing.
    c. the counter gear, anti-lash plate may be worn or damaged.
    d. a defective input shaft bearing.

37.11.02.05.

21. Before removal of a transmission, what should you do for a safety measure?

    a. remove clutch assembly.
    b. disconnect battery.
    c. drain gas tank.
    d. remove drive shaft.

37.11.02.05. cont.

22. What part must be marked before removal?

    a. clutch disc.
    b. U-joints.
    c. transmission bolts.
    d. throw-out bearing.

23. Failure to utilize a transmission jack during standard transmission removal will often result in what kind of injury?

    a. personal injury.
    b. output shaft injury.
    c. cam shaft injury.
    d. input shaft injruy.

24. Before you can remove the transmission, you first must remove the:

    a. input shaft.
    b. throw-out bearing.
    c. drive shaft.
    d. pressure plate.

25. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:

    a. input shaft.
    b. pressure plate.
    c. U-joint yoke.
    d. throw-out bearing.

37.11.02.06.

26.

27.

28. When disassembling a standard transmission, if a hammer needs to be used, what type should you use?

    a. a soft face hammer.
    b. none at all.
    c. not more than 3 lb. hammer.
    d. a small ballpeen hammer.

37.11.02.06. cont.

29. Although basic transmission designs are similar, the disassembly procedure:

    a. stays the same.
    b. can only be done after the clutch removal.
    c. varies.
    d. can be done on the car.

30. When removing a synchronizer, it is important to keep what in each side of it to insure proper assembly?

    a. counter shaft.
    b. shifting forks.
    c. blocking rings.
    d. reverse idler gear.

37.11.02.07.

31. A rear seal can be removed:

    a. by shrinking it using dry ice.
    b. with a slide hammer.
    c. by pressing it off.
    d. with heat, by expanding it.

32. When putting a front seal on a transmission, you have it facing:

    a. with lip facing the right of the housing.
    b. with lip in.
    c. with lip out.
    d. with lip facing the left of the housing.

33. When replacing an input shaft bearing, you need to:

    a. be sure it is completely dry.
    b. put sealer on it.
    c. lubricate it.
    d. be sure it is rippled on the surface.

34. You can replace a front oil seal by:

    a. removing bell housing.
    b. removing throw-out bearing.
    c. removing clutch.
    d. removing transmission.

35. It is possible to secure any degree of torque multiplication by:

    a. a set of various gears.
    b. a heavier clutch.
    c. a larger engine.
    d. a larger torque amplifier.

37.11.02.08.

36. The shaft assembly that usually comes out of the casing last is the:

    a. reverse idler gear assembly.
    b. countershaft gear assembly.
    c. input shaft gear assembly.
    d. output shaft gear assembly.

37. One method used to secure a counter shaft is to:

    a. use a set screw.
    b. use a roll pin.
    c. use an allen screw.
    d. use a bolt and nut.

38. The output shaft bearing surfaces should be smooth with:

    a. no evidence of galling.
    b. galling formations evident.
    c. excessive play when gears are on.
    d. excessive racking when gears are on.

39. All snap ring grooves must have:

    a. rounded shoulders.
    b. square shoulders.
    c. bevelled shoulders.
    d. stepped shoulders.

40. If a gear has a blocking ring surface, it must be:

    a. rounded.
    b. rippled.
    c. uneven.
    d. smooth.

37.11.02.09.

41. On the hub you should check for wear on the inner:

    a. splines.
    b. fine grooves.
    c. cane surface.
    d. course grooves.

42. How many inserts does a synchronizer hub have?

    a. 3.
    b. 2.
    c. 1.
    d. 4.

37.11.02.09. cont.

43. Which of the following must be reassembled in the same manner as it was taken apart?

    a. inserts.
    b. third-speed gear.
    c. sleeve.
    d. spring inserts.

44. When assembling a synchronizer, you should lubricate with:

    a. light 10 weight oil.
    b. transmission lube.
    c. light weight grease.
    d. graphite.

45. In order to insure that the blocking rings are put on the hub the same way they were taken off, you should:

    a. scribe them.
    b. draw a picture of them.
    c. count the gear teeth on each side.
    d. write on them to tell which side is which.

37.11.02.10.

46. When the countershaft is in place, you should check end play with a(n):

    a. oscilloscope.
    b. feeler gauge.
    c. depth gauge.
    d. micrometer.

47. If drive-in expander plugs were removed:

    a. install new ones.
    b. lubricate well and install.
    c. install again but do not use a sealer.
    d. dry thoroughly and install.

48. When pins pass through the outer wall of the case, what should you do to prevent them from slipping out?

    a. lubricate them.
    b. stake them.
    c. lead hole in.
    d. glue pin to hole.

49. Before installation of a standard transmission every part should be:

    a. sanded or emery-clothed.
    b. heavily lubricated.
    c. greased thoroughly.
    d. dried completely.

37.11.02.10. cont.

50. When assembling a standard transmission, new thrust washers will provide:

a. proper end play.
b. a tight fit with no end play.
c. help to stop oil leakage.
d. a locking mechanism for the shaft.

37.11.02.11.

51. When adjusting the linkage on a car, the transmission should be:

a. in neutral.
b. just overhauled.
c. in high gear.
d. out of the car.

52. To install the shift cover, you must place the transmission in:

a. reverse.
b. low.
c. high.
d. neutral.

53. To hold a typical four-speed linkage in neutral while adjusting the linkage, you would use a:

a. retaining pin.
b. dust boat.
c. alignment pin.
d. pinion carrier.

54.

55. To adjust transmission linkages, you must:

a. use a dial indicator.
b. use an oscilloscope.
c. use a feeler gauge.
d. remove them from the transmission.

PRETEST

UNIT TEST ANSWER SHEET

Occupational Area: ____________________
File Code: 37.11.02 00.B1-2
Name: ____________________
Family Pay Number ____________________ Sex M F (Circle 1)

ANSWERS

87.11.02.01	1.	A	37.11.02.05	21.	B	37.11.02.09	41.	A
	2.	B		22.	B		42.	A
	3.	C		23.	A		43.	C
	4.	C		24.	C		44.	B
	5.	C		25.	C		45.	A
87.11.02.02	6.	B	37.11.02.06	26.	B	37.11.02.10	46.	B
	7.	D		27.	C		47.	A
	8.	C		28.	A		48.	B
	9.	A		29.	C		49.	B
	10.	B		30.	C		50.	A
87.11.02.03	11.	D	37.11.02.07b	31.	B	37.11.02.11	51.	A
	12.	B		32.	B		52.	[illegible]
	13.	D		33.	C		53.	C
	14.	A		34.	D		54.	D
	15.	C		35.	A		55	D
87.11.02.04	16.	A	37.11.02.08	36.	A		56.	
	17.	C		37.	B		57.	
	18.	A		38.	A		58.	
	19.	D		39.	B		59.	
	20.	A		40.	D		60.	

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File Code: 37.11.02.01.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Fundamentals of Three-Speed Standard

OBJECTIVE:

Recognize the components and the proper operation of the automotive three-speed standard transmission.

EVALUATION PROCEDURE:

Score at least 80% correct on the LAP study questions and 80% accuracy on LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and secure a quiet place to study.
2. Study Chapter 10, pages 211-223.
3. On separate paper, answer questions 1 through 19 on page 223.
4. Give your answer sheet to the instructor for evaluation.
5. Return the text.
6. Take the LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.02.01.B1-2

Date: ______________________ Date Published: 3/10/76

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LAP TEST: FUNDAMENTALS OF 3-SPEED STANDARD

1. A gear should never be reused if the teeth show any signs of:

   a. no sharp edges.
   b. galling.
   c. no excessive play.
   d. smooth.

2. What is the gear ratio of a setup where the driving gear has 20 teeth and the driven gear has 50?

   a. 4 to 10
   b. 2.5 to 1
   c. 5 to 20
   d. 1 to 2.5

3. Low gear in a three-speed transmission has an approximate gear ratio of:

   a. 4 to 1.
   b. 3 to 1.
   c. 1 to 1.
   d. 2 to 1.

4. A torque multiplier is another name for a:

   a. supercharger.
   b. camshaft.
   c. transmission.
   d. crankshaft.

5. The countershaft is often held in place by:

   a. reverse idler shaft.
   b. anti-lash plate.
   c. staking.
   d. a back pin.

6. When a manual transmission is shifted into reverse, what extra gear is interposed to reverse the direction of the main shaft?

   a. reverse idler gear
   b. reverse synchromesh ring
   c. low and reverse sliding gear
   d. countershaft gear

7. The control device that connects and disconnects the overdrive unit is the:

   a. governor.
   b. solenoid.
   c. relay.
   d. second gear.

8. The gear that runs the noisiest of all gear types is the:

   a. helical gear.
   b. spur gear.
   c. face gear.
   d. flank gear.

9. Second gear in a three-speed transmission has an approximate gear ratio of:

   a. 2 to 1.
   b. 1 to 1.
   c. 3 to 1.
   d. 4 to 1.

10. Which two normal transmission shafts turn in neutral?

   a. main shaft and countershaft
   b. input shaft and main shaft
   c. main shaft and input shaft
   d. input shaft and countershaft

LAP TEST ANSWER KEY: FUNDAMENTALS OF 3-SPEED STANDARD

1. b
2. b
3. b
4. c
5. d
6. a
7. b
8. b
9. a
10. d

File Code: 37.11.02.02.B1-0

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Fundamentals of Four-Speed Standard

OBJECTIVE:

Recognize the components and the proper operation of the automotive 4-speed standard transmission.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions.

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Fundamentals of Overdrive" LAP test and is taken after completing that LAP.

RESOURCES: PR[illegible]

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 10, pp. 211-223.
   NOTE: Pay particular attention to the section on four-speed transmission and the note on page 222.
3. On separate paper, answer questions 20 through 30 on page 223.
4. Give your answer sheet to the instructor for evaluation.
5. Return the text.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W[illegible]sland

File Code: 37.11.02.03.B1-0

Date Published: 8/17/76

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Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: Fundamentals of Overdrive

OBJECTIVE:

Identify the components and describe the operation of the transmission overdrive.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions in this LAP and 80% on the LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 11, page 225 to 233.
3. On separate paper, answer questions 1 through 26 on pages 232-233.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Take the LAP test.
7. Proceed to next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.02.02-.03 B1-2

Date: ____________________ Date Published: 12-6-77

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LAP TEST: FUNDAMENTALS OF 4-SPEED STANDARD/OVERDRIVE

37.11.02.02

1. Generally, all four forward gears in a four-speed transmission are:

   a. not driving the mainshaft.
   b. on separate shafts.
   c. synchronized.
   d. not backed with a synchronizer assembly.

2. Four-speed transmissions are most popular in cars with:

   a. high performance engines.
   b. 422 rear end gear.
   c. 411 rear end gear.
   d. low compression engines.

3. One type of a transmission housing is made of:

   a. pewter.
   b. special steel.
   c. cast iron.
   d. magnesium.

4. A material that is also used in the construction of a transmission housing is:

   a. centrifugal alloy.
   b. aluminum.
   c. magnesium.
   d. spring steel.

5. In most synchronized transmission designs:

   a. third and fourth gears are engaged by sliding a clutch sleeve.
   b. third and fourth gears are engaged by sliding the appropriate sleeve.
   c. first and reverse gears remain meshed all the time.
   d. use helical gears because of the ease with which they can be slid to mesh with other gears.

37.11.02.03

6. At about what speed will the overdrive kick in or become operative?

   a. 15 mph
   b. 30 mph
   c. 10 mph
   d. 20 mph

37.11.02.03

7. The internal gear on an overdrive meshes with the:

   a. cluster gear.
   b. back gear.
   c. low gear.
   d. planet pinions.

8. An overdrive is attached:

   a. to the side of the transmission.
   b. in the transmission.
   c. to the rear of the transmission.
   d. to the top of the transmission.

9. What shaft in the transmission drives the overdrive?

   a. reverse idler shaft.
   b. input shaft.
   c. output shaft.
   d. countershaft.

10. The planet pinions revolve around the:

   a. back gear.
   b. sun gear.
   c. ring gear.
   d. shift fork.

LAP TEST ANSWER KEY: FUNDAMENTALS OF 4-SPEED STANDARD/OVERDRIVE

LAP 02

1. c
2. a
3. c
4. b
5. a

LAP 03

6. b
7. d
8. c
9. c
10. b

File Code: 37.11.02.04.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Troubleshooting Standard Transmissions

OBJECTIVE:

Troubleshoot a standard transmission.

EVALUATION PROCEDURE:

Score with 80% accuracy on the LAP test.

RESOURCES:

Auto Service and Repair. Stockel.

Automobile with standard transmission problem

PROCEDURE:

1. Ask the customer what his transmission has been doing and what he thinks the problem is. Record the information.
2. If the car is drivable, test drive. Record everything about the transmission. NOTE: During the road test, accelerate and decelerate in each gear and at various speeds. Watch for gear clash, vibration, noises, jumping out of gear. Sometimes clutch pedal free play adjustment is responsible for hard and noisy shifting.
3. Summarize your findings. Record the problem, the possible causes, and the corrective action for each cause. Refer to pages 25-35 to 25-29 in Auto Service and Repair.
4. Ask the instructor to evaluate your work.
5. Take the LAP test.

Principal Author(s): C. Schramm

Student: ______________________ File Code: 37.11.02.04.B1-2

Date: ______________________ Date Published: 3/10/76

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Glasgow AFB, Montana 59231

LAP TEST: TROUBLESHOOTING STANDARD TRANSMISSIONS

37.11.02.04.

1. After you have compiled the data on what is wrong with the transmission, you:

   a. take transmission out of car.
   b. mark on a piece of paper.
   c. record a work order.
   d. make a mental note of it.

2. When the transmission shifts hard in all gears, it could be:

   a. counter gear anti-lash plate worn or damaged.
   b. wrong transmission lubricant.
   c. worn or damaged input shaft bearing.
   d. defective input shaft bearing.

3. To get a basic idea of what is wrong with the transmission, before you drive the car you can:

   a. ask owner what it is doing.
   b. raise car and visually inspect.
   c. raise car and use block light.
   d. raise car and wash.

4. To adjust excessive clutch pedal free travel, you would:

   a. adjust shift linkage.
   b. adjust pedal linkage.
   c. adjust clutch.
   d. use a stronger return spring.

5. One possible reason the overdrive won't engage might be:

   a. insufficient ball ring tension.
   b. the roller clutch cam is worn.
   c. the relay fuse is blown out.
   d. the kickdown switch is grounded.

LAP TEST ANSWER KEY: TROUBLESHOOTING STANDARD TRANSMISSIONS

1. c
2. b
3. a
4. b
5. c

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Transmission Removal

OBJECTIVE:

Recognize and follow the correct procedure to remove a standard transmission from an automobile.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Transmission Disassembly" LAP test and is taken after completing that LAP.

RESOURCES:

Motor's Auto Repair Manual.

Automobile equipped with standard transmission
Jack and jack stands
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Raise the vehicle and place the jack stands in correct position.
2. Obtain the repair manual for the model and year that you are working on.
   NOTE: The removal procedure may differ slightly from model to model. The repair manual will explain the steps to follow for each model and year.
3. Following the procedure steps outlined in the manual, remove the transmission from the automobile.
4. Ask the instructor to evaluate your work.
5. Return tools, equipment, and manuals to their proper places.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.02.06.B1-0

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Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Transmission Disassembly

OBJECTIVE:

Recognize and follow the proper procedure to disassemble an automobile standard transmission.

EVALUATION PROCEDURE:

80% accuracy on the LAP test.

RESOURCES:

Motor's Auto Repair Manual.

Standard transmission
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Place the transmission on a work bench.
   NOTE: Be careful not to lose the needle bearings at the gear end of the input shaft.
2. Obtain the repair manual for the year and model of your particular transmission.
3. Following the disassembly procedure in the manual, disassemble the transmission.
   NOTE: As parts are removed from the transmission, lay them on a clean rag in the order that they are removed. This will save time later during reassembly of the transmission.
4. Ask the instructor to evaluate your work.
5. Return tools and manual to their proper places.
6. Take the LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.02.05-.06 B1-2

Date: ____________________ Date Published: 12-6-77

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LAP TEST: TRANSMISSION REMOVAL/DISASSEMBLY

37.11.02.05

1. When removing linkage from a transmission, you should also:

   a. remove overdrive unit if transmission has one.
   b. remove pressure plate.
   c. mark them.
   d. remove reverse idler shaft.

2. Worn transmission interlocks should be replaced because the condition could cause:

   a. damage to the synchronizers.
   b. the transmission to engage two gears at the same time.
   c. sluggish shifting in cold weather.
   d. chattering in reverse.

3. Failure to utilize a transmission jack during standard transmission removal will often result in what kind of injury?

   a. personal injury.
   b. input shaft injury.
   c. output shaft injury.
   d. camshaft injury.

4. What part must be marked before removal?

   a. U-joints.
   b. clutch disc.
   c. throw-out bearing.
   d. transmission bolts.

5. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:

   a. throw-out bearing.
   b. pressure plate.
   c. drive shaft.
   d. input shaft.

37.11.02.06

6. When repairing a transmission, if a hammer needs to be used, what type should you use?

   a. a small ballpeen hammer.
   b. none at all.
   c. not more than 3 lb. hammer.
   d. a soft-face hammer.

37.11.02.06 (continued)

7. Although basic transmission designs are similar, the disassembly procedure:

   a. Stays the same.
   b. varies.
   c. can be done on the car.
   d. can not be done.

8. When removing the synchronizer, it is important to keep what on each side of it to insure proper assembly?

   a. countershaft.
   b. reverse idler gear.
   c. shifting forks.
   d. blocking rings.

9. To remove the output or input shaft, you must first remove the:

   a. low gear.
   b. housing.
   c. pressure plate.
   d. counter gear.

10. To remove the output shaft you first have to remove the:

   a. shifter shaft.
   b. speedometer drive gear.
   c. low gear.
   d. pressure plate.

LAP TEST ANSWER KEY: TRANSMISSION REMOVAL/DISASSEMBLY

LAP .05

1. C
2. B
3. A
4. A
5. C

LAP .06

6. D
7. B
8. D
9. D
10. B

File Code: 37.11.02.07.B1-0

Date Published: 3/10/76

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Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: Bearings and Seals

OBJECTIVE:

Recognize and follow the proper procedure to replace the bearings and seals in an automobile automatic transmission.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test.
"Transmission Assembly" LAP test and is [illegible]

RESOURCES:

Motor's Auto Repair Manual.

Bearings and seals if needed
Puller
Snap-ring pliers
Standard transmission
Tools, BASIC HAND: (See Unit LEG)
Work order form

PROCEDURE:

1. With the disassembled transmission on the work bench, write on the work order all bearings and seals that need replacing.
   NOTE: If a seal is leaking, is hard or cracked, it needs replacement. Check bearings and race for play, chips and wear marks. Check the manual for bearing tolerances.
2. Obtain the correct repair manual for the transmission to be worked on.
3. Following the procedure outlined in the manual, replace the bearings and seals that are listed on the work order.
4. Ask the instructor to evaluate your work.
5. Return manuals and tools to their proper places.
6. Take LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.02.07.B1-2

Date: ______________________ Date Published: 3/10/76

Revised: 12-10-79

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LAP TEST: BEARINGS AND SEALS

1. It is possible to secure any degree of torque multiplication by:

   a. a larger engine.
   b. a heavier clutch.
   c. a set of various gears.
   d. a larger torque amplifier.

2.

   a.
   b.
   c.
   d.

3. A rear transmission seal can be removed:

   a. by shrinking it using dry ice.
   b. by pressing it off.
   c. with a slide hammer.
   d. by heat, by expanding it.

4. When overhauling a direct clutch and piston assembly, what do you do with the old seals?

   a. discard them
   b. clean with a clean rag
   c. clean in gasoline
   d. clean in carburetor cleaner

5. In order to replace a front oil seal in a standard transmission you must remove the:

   a. transmission.
   b. clutch.
   c. throw-out bearing.
   d. bell housing.

LAP TEST ANSWER KEY: BEARINGS AND SEALS

1. c
2.
3. c
4. a
5. a

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File Code: 37.11.02.08.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Gears and Shafts

OBJECTIVE:

Recognize and follow the proper procedure to replace the gears and shafts in an automobile standard transmission.

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Synchronizers" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Service and Repair. Stockel.
Motor's Auto Repair Manual.

Puller
Snap-ring pliers
Standard transmission
Tools, Basic Hand: (See Unit LEG)
Work order form

PROCEDURE:

NOTE: Read Chapter 25 in Auto Service and Repair.

1. With the disassembled transmission on the work bench, write on the work order all gears and shafts that need replacing.
   NOTE: Look for chips, scores, missing teeth, and wear marks. Rock the gears back and forth to estimate the clearance.
2. Obtain a copy of a repair manual for the type of transmission to be worked on.
3. Following the procedure outlined in the repair manual, replace the gears and shafts that were listed on the work order.
4. Ask the instructor to evaluate your work.
5. Return manual and tools to their proper places.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.02.09.B1-0

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Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Synchronizers

OBJECTIVE:

Recognize and follow the correct procedure to replace the synchronizers in an automobile standard transmission.

EVALUATION PROCEDURE:

80% accuracy on the LAP test.

RESOURCES:

Motor's Auto Repair Manual.

Standard transmission
Synchronizers if needed
Tools, Basic Hand: (See Unit LEG)
Work order form

PROCEDURE:

1. With the disassembled transmission on the work bench, write on the work order all synchronizers that need replacing. Check for wear, play, and see that no teeth are tapered or chipped.
   NOTE: When disassembling the synchronizer assembly for inspection, mark each ring and hub so that they can be reassembled in original order and position.
2. Obtain a copy of the repair manual for the year and model number of the transmission to be worked on.
3. Following the procedure outlined in the repair manual, replace the synchronizers that are listed on the work order.
4. Ask the instructor to evaluate your work.
5. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.02.08.B1-2
37.11.02.09.B1-2

Date: ______________________ Date Published: 3/10/76

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LAP TEST: GEARS AND SHAFTS/SYNCHRONIZERS

37.11.02.08.

1. The cluster gear is removed by removing the:

    a. output shaft assembly.
    b. countershaft.
    c. reverse idler shaft.
    d. anti-lash plate.

2. If a gear has a blocking ring surface, it must be:

    a. uneven.
    b. rippled.
    c. smooth.
    d. rounded.

3. By using a flat plate to secure the countershaft, a notch is put into the:

    a. countershaft.
    b. reverse idler shaft and countershaft.
    c. countershaft and the housing.
    d. reverse idler shaft.

4. All snap ring grooves must have:

    a. rounded shoulders.
    b. bevelled shoulders.
    c. square shoulders.
    d. stepped shoulders.

5. The output shaft bearing surfaces should be smooth with:

    a. galling formations evident.
    b. excessive racking when gears are on.
    c. excessive play where gears are on.
    d. no evidence of galling.

37.11.02.09.

6. When assembling a synchronizer, you should lubricate with:

   a. light weight grease.
   b. light 10 weight oil.
   c. graphite.
   d. transmission lube.

7. On the hub you should check for wear on the inner:

   a. cane surface.
   b. fine grooves.
   c. splines.
   d. course grooves.

8. In order to insure that the blocking rings are put on the hub the same way they were taken off, you should:

   a. scribe them.
   b. draw a picture of them.
   c. write on them to tell which side is which.
   d. count the gear teeth on each side.

9. Which of the following parts must be reassembled in the same manner it was taken apart?

   a. third speed gear
   b. inserts
   c. spring inserts
   d. sleeve

10. The hub has slots in it so which of the following parts can be fitted into it?

    a. inserts
    b. sleeve
    c. blocking ring
    d. snap ring

37.11.02.08.B1-2
37.11.02.09.B1-2

LAP TEST ANSWER KEY: GEARS AND SHAFTS/SYNCHRONIZERS

LAP .08

1. b
2. c
3. b
4. c
5. d

LAP .09

6. d
7. c
8. a
9. d
10. a

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Date Published: 3/10/76

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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Transmission Assembly

OBJECTIVE:

Recognize and follow the proper procedure to assemble a standard transmission.

EVALUATION PROCEDURE:

80% accuracy on the LAP test.

RESOURCES:

Motor's Auto Repair Manual.

Gaskets
Grease
Sealant
Snap rings
Snap-ring pliers
Standard transmission
Tools, Basic Hand: (See Unit LEG)
Transmission oil

PROCEDURE:

1. Check to see that all parts are clean.
2. Obtain a copy of the repair manual for the year and model number of the particular transmission to be assembled.
3. Assemble the transmission following the procedure outlined in the repair manual.
   NOTE: Heavily lubricate all parts with transmission oil before assembling. Use new snap-rings whenever possible. Use new gaskets and sealant to prevent leaks. Use grease to hold needle bearings in place during assembly.
4. Ask the instructor to evaluate your work.
5. Return manual, tools, and equipment to their proper places.
6. Take the LAP test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________________ **File Code:** 37.11.02.10.B1-2

Date: ______________________________ **Date Published:** 11-28-77

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LAP TEST: TRANSMISSION ASSEMBLY

1. Before installation of a transmission assembly, every part should be:

   a. greased thoroughly.
   b. dried completely.
   c. sanded or emery clothed.
   d. heavily lubricated.

2. To install a reverse idler shaft in a transmission using needle bearings, the preferred procedure is to use:

   a. a heavy grease to hold the rollers.
   b. a dummy shaft.
   c. a press.
   d. tweezers.

3. When pins pass through the outer wall of the case, what should you do to prevent them from slipping out?

   a. lead hole in.
   b. stake them.
   c. lubricate them.
   d. glue pin to hole.

4. When installing a new part in a transmission, it is important to try it in the transmission to be sure it:

   a. has excessive play.
   b. has excessive clearance for heat expansion.
   c. wobbles on the shaft.
   d. fits properly.

5. New thrust washers, when assembling a transmission, will provide:

   a. proper end play.
   b. and act as an oil seal.
   c. tight fit with no end play.
   d. a backing mechanism for the shaft.

LAP TEST ANSWER KEY: TRANSMISSION ASSEMBLY

1. D
2. A
3. B
4. D
5. A

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File Code: 37.11.02.11.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Shift Forks and Linkage

OBJECTIVE:

Recognize and follow the proper procedure to install the standard transmission shift cover and adjust the linkage

EVALUATION PROCEDURE:

Successful completion of this LAP is determined by correctly answering at least 8 out out of 10 items on a multiple-choice test. [illegible] "[illegible] Standard Transmissions" [illegible] that LAP.

RESOURCES:

Motor's Auto Repair Manual.

Gasket cement
Shift cover gasket
Standard transmission
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Place the transmission in neutral.
2. Place the shift forks in the neutral position.
3. Cement the gasket to the shift cover and install the cover.
   NOTE: Hold the shift cover in line with the shift cover hole and "eyeball" the alignment of the shift forks with the shift fork grooves. If they do not appear to line up, move the shift forks so that they do. Try the shift mechanism to be sure that the cover is installed properly.
4. Obtain the repair manual for the year and model that you are working on.
5. Following the procedure outlined in the manual, adjust the linkage.
6. Ask the instructor to evaluate your work.
7. Return tools and manual and clean work area.
8. Take LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.02.11.B1-2

Date: ______________________ Date Published: 3-10-76
Revised: 8-15-78

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LAP TEST: SHIFT FORKS AND LINKAGE

1. When installing a shift fork cover, the shift forks must align with the:

   a. pressure plate.
   b. countershaft.
   c. pilot bearing.
   d. gear fork grooves.

2. To adjust transmission linkages, you must:

   a. use a feeler gauge.
   b. use an oscilloscope.
   c. use a dial indicator.
   d. remove them from the transmission.

3. If the linkage on a shift column has slotted adjustment holes, you:

   a. take linkage completely off.
   b. just loosen adjustment nuts and leave shift rods connected.
   c. weld linkage in place.
   d. put shift levers in reverse

4. When adjusting the linkage on a car, the transmission should be:

   a. in neutral.
   b. in high gear.
   c. just overhauled.
   d. out of the car.

5. It is essential that the shift cover have a:

   a. heavy coat of grease.
   b. light coat of oil.
   c. gasket.
   d. light coat of grease.

LAP TEST ANSWER KEY: SHIFT FORKS AND LINKAGE

1. d
2. d
3. b
4. a
5. c

Student: ______________________ File Code: 37.11.02.00.C1-2 (A)

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Revised: 8-15-78

Mountain-Plains Education &
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UNIT POST TEST: STANDARD TRANSMISSIONS (A)

37.11.02.01

1. Synchronized insert springs should be installed with:

   a. the free ends down.
   b. both on one side.
   c. the free ends up.
   d. one on each side.

2. The type of gear which is the most superior of all the gears is the:

   a. spur gear.
   b. face gear.
   c. flank gear.
   d. helical gear.

3. A torque multiplier is another name for a:

   a. transmission.
   b. supercharger.
   c. camshaft.
   d. crankshaft.

4. Second gear in a three-speed transmission has an approximate gear ratio of:

   a. 3 to 1.
   b. 4 to 1.
   c. 1 to 1.
   d. 2 to 1.

5. The control device that connects and disconnects the overdrive unit is:

   a. second gear.
   b. the governor.
   c. the relay.
   d. the solenoid.

6. Mechanic "A" says too much clutch pedal free play may cause the clutch to drag when disengaged.

   Mechanic "B" says not enough clutch pedal free play may cause the clutch to slip when engaged.

   a. "A" only. b. "B" only. c. Both "A" and "B". d. Neither "A" nor "B"

37.11.02.02 (continued)

7. The shafts of a transmission usually revolve on:

    a. roller or ball bearings.
    b. blocking rings.
    c. brass bearings.
    d. gears.

8. Generally, all four forward gears in a four-speed transmission are:

    a. synchronized.
    b. not driving the main shaft.
    c. not backed with a synchronizer assembly.
    d. on separate shafts.

9. A material that is used in the construction of a transmission housing is:

    a. centrifugal alloy.
    b. spring steel.
    c. aluminum.
    d. magnesium.

10. Four-speed transmissions are most popular in cars with:

    a. high performance engines.
    b. 411 rear end gear.
    c. 422 rear end gear.
    d. low compression engines.

37.11.02.03

11. At about what speed will the overdrive kick in or become operative?

    a. 15 mph.
    b. 20 mph.
    c. 10 mph.
    d. 30 mph.

12. An overdrive will give speed reduction for the engine of about what percent?

    a. 75%
    b. 50%
    c. 30%
    d. 60%

13. The internal gear on an overdrive meshes with the:

    a. low gear.
    b. planet pinions.
    c. back gear.
    d. cluster gear.

37.11.02.03 (continued)

14. What shaft in the transmission drives the overdrive?

    a. input shaft.
    b. output shaft.
    c. reverse idler shaft.
    d. counter shaft.

15. The planet pinions revolve around the:

    a. shift fork.
    b. back gear.
    c. ring gear.
    d. sun gear.

37.11.02.04

16. All of these can cause hard shifting into gear EXCEPT:

    a. the clutch not releasing completely.
    b. a sliding gear loose on the main shaft splines.
    c. worn synchronizers (blocker rings).
    d. gearshift linkage out of adjustment.

17. Before working on a transmission, it is also advisable to do what:

    a. test drive.
    b. use a black light.
    c. clean transmission thoroughly.
    d. read manual on assembly procedure.

18. After you have compiled the data of what is wrong with the transmission, you:

    a. make a mental note of it.
    b. record a work order.
    c. mark on a piece of paper.
    d. take transmission out of car.

19. To adjust excessive clutch pedal free travel, you would:

    a. use a stronger return spring.
    b. adjust pedal linkage.
    c. adjust shift linkage.
    d. adjust clutch.

20. When the transmission shifts hard in all gears, it could be:

    a. counter gear anti-lash plate worn or damaged.
    b. worn or damaged input shaft bearing.
    c. wrong transmission lubricant.
    d. defective input shaft bearing.

37.11.02.05

21. Failure to utilize a transmission jack during standard transmission removal will often result in what kind of injury?

    a. personal injury.
    b. input shaft injury.
    c. output shaft injury.
    d. cam shaft injury.

22. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:

    a. throw-out bearings.
    b. input shaft.
    c. pressure plate.
    d. U-joint yoke.

23. Before you can remove the transmission, you first must remove the:

    a. pressure plate.
    b. throw-out bearing.
    c. drive shaft.
    d. input shaft.

24. What part must be marked before removal?

    a. U-joints.
    b. transmission bolts.
    c. throw-out bearings.
    d. clutch disc.

25. In a four-speed fully synchronized transmission, there is a clunking or knocking noise in only first and reverse.

    Mechanic "A" says that a broken tooth on the main dirve gear could be the cause.

    Mechanic "B" says that a broken tooth on the countershaft (cluster) gear could be the cause.

    a. "A" only. b. "B" only. c. Either "A" or "B". d. Neither "A" nor "B".

37.11.02.06

26. Although basic transmission designs are similar, the disassembly procedure:

    a. varies.
    b. stays the same.
    c. can be done on the car.
    d. can only be done after the clutch removal.

37.11.02.06 (continued)

27. Mechanic "A" says that installing a two-piece driveshaft, with the U-joints out of phase, may cause a driveline vibration.

    Mechanic "B" says that when you install new U-joints on a single piece driveshaft, care must be taken to properly properly phase the joints. Who is right?

    a. "A" only. b. "B" only. c. Both "A" and "B". d. Neither "A" nor "B".

28. If the transmission is noisy in neutral, chances are the:

    a. clutch is slipping, the gear teeth are stripped, or the fork is bent.
    b. transmission is misaligned or the gears are worn.
    c. linkage is out of adjustment or the speedometer gears are worn.
    d. none of the above.

29. When removing a synchronizer, it is important to keep what on each side of it to insure proper assembly?

    a. blocking rings.
    b. shifting forks.
    c. reverse idler gear.
    d. counter shaft.

30. To remove the output shaft, you first have to remove the:

    a. low gear.
    b. speedometer drive gear.
    c. pressure plate.
    d. shifter shaft.

37.11.02.07

31. When replacing an input shaft bearing, you need to:

    a. put sealer on it.
    b. lubricate it.
    c. be sure it is completely dry.
    d. be sure it is rippled on the surface.

32. It is possible to secure any degree of torque multiplication by:

    a. a heavier clutch.
    b. a larger torque amplifier.
    c. a larger engine.
    d. a set of various gears.

33. You can replace a front oil seal by:

    a. removing throw-out bearing.
    b. removing clutch.
    c. removing transmission.
    d. removing bell housing.

37.11.02.07 (continued)

34. When putting a front seal on a transmission, you have it facing:
    a. with lip facing the left of the housing.
    b. with lip out.
    c. with lip facing the right of the housing.
    d. with lip in.

35. To remove a rear oil seal, you can do so by:
    a. taking the transmission out.
    b. removing the drive shaft.
    c. removing the pressure plate.
    d. removing the throw-out bearing.

37.11.02.08

36. The output shaft can be removed as a:
    a. cluster gear.
    b. dual assembly.
    c. triple assembly.
    d. complete assembly.

37. The output shaft bearing surfaces should be smooth with:
    a. excessive racking when gears are on.
    b. galling formations evident.
    c. no evidence of galling.
    d. excessive play where gears are on.

38. If a gear has a blocking ring surface, it must be:
    a. rounded.
    b. uneven.
    c. rippled.
    d. smooth.

39. The cluster gear is removed by removing the:
    a. output shaft assembly.
    b. reverse idler shaft.
    c. anti-lash plate.
    d. counter shaft.

40. One method used to secure a counter shaft is to:
    a. use a roll pin.
    b. use a set screw.
    c. use a bolt and nut.
    d. use an allen screw.

37.11.02.09

41. In order to insure that the blocking rings are put on the hub the same way they were taken off, you should:

    a. write on them to tell which side is which.
    b. draw a picture of them.
    c. scribe them.
    d. count the gear teeth on each side.

42. On the hub you should check for wear on the inner:

    a. vane surface.
    b. fine grooves.
    c. splines.
    d. course grooves.

43. When assembling a synchronizer, you should lubricate with:

    a. transmission lube.
    b. graphite.
    c. light 10 weight oil.
    d. light weight grease.

44. The hub has slots in it so which of the following parts can be fitted into it?

    a. blocking ring.
    b. sleeve.
    c. inserts.
    d. snap ring.

45. How many inserts does a synchronizer hub have?

    a. 2
    b. 3
    c. 1
    d. 4

37.11.02.10

46. New thrust washers, when assembling a transmission, will provide:

    a. and act as an oil seal.
    b. tight fit with no end play.
    c. proper end play.
    d. a backing mechanism for the shaft.

47. If drive-in expander plugs were removed:

    a. lubricate well and install.
    b. install new ones.
    c. dry thoroughly and install.
    d. install again but do not use a sealer.

37.11.02.10 (continued)

48. When pins pass through the outer wall of the case, what should you do to prevent them from slipping out?

  a. glue pin to hole.
  b. lubricate them.
  c. lead hole in.
  d. stake them.

49. In first-speed gear, the power travels through the clutch shaft and the countershaft:

  a. drive gear, second gear, first gear, and shaft.
  b. low gear, drive gear, low and reverse gear, and main shaft.
  c. drive gear, low gear, low and reverse gear, and main shaft.
  d. none of the above.

50. When the counter shaft is in place, you should check end play with a:

  a. oscilloscope.
  b. micrometer.
  c. feeler gauge.
  d. depth gauge.

37.11.02.11

51. To install the shift cover, you must place the transmission in:

  a. neutral.
  b. low.
  c. high.
  d. reverse.

52. When installing a shift fork cover, the shift forks must align with:

  a. gear fork covers.
  b. pilot bearing.
  c. pressure plate.
  d. countershaft.

53. It is essential that the shift cover have a:

  a. light coat of oil.
  b. gasket.
  c. light coat of grease.
  d. heavy coat of grease.

54. When adjusting the linkage on a car, the transmission is:

  a. in neutral.
  b. out of the car.
  c. just overhauled.
  d. in high gear.

UNIT POST TEST ANSWER KEY: STANDARD TRANSMISSIONS

Occupational Area: _______________
File Code: 37.11.02.00.CI-2 (A)
Name: _______________
Family Pay Number: _______________ Sex: M F (Circle 1)

ANSWERS

37.11.02.01	1.	D _____	37.11.02.05	21.	A _____	37.11.02.09	41	C _____
	2.	D _____		22.	D _____		42	C _____
	3.	A _____		23.	C _____		43	A _____
	4.	D _____		24.	A _____		44	C _____
	5.	D _____		25.	B _____		45	B _____
37.11.02.02	6.	B _____	37.11.02.06	26.	A _____	37.11.02.10	46	C _____
	7.	A _____		27.	A _____		47	B _____
	8.	A _____		28.	B _____		48	D _____
	9.	C _____		29.	A _____		49	C _____
	10.	A _____		30.	B _____		50	C _____
37.11.02.03	11.	D _____	37.11.02.07	31.	B _____	37.11.02.11	51	A _____
	12.	C _____		32.	D _____		52	A _____
	13.	B _____		33.	C _____		53	B _____
	14.	B _____		34.	D _____		54	A _____
	15.	D _____		35.	B _____		55.	_____
37.11.02.04	16.	C _____	37.11.02.08	36.	D _____		56.	_____
	17.	A _____		37.	C _____		57.	_____
	18.	B _____		38.	D _____		58.	_____
	19.	B _____		39.	D _____		59.	_____
	20.	C _____		40.	A _____		60.	_____

Student: ______________________ **File Code:** 37.11.02.00.C1-2 (B)

Date: ______________________ **Date Published:** 6-9-77

Revised 9-11-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT POST TEST: STANDARD TRANSMISSIONS (B)

37.11.02.01

1. The control device that connects and disconnects the overdrive unit is:

    a. second gear
    b. the governer
    c. the relay
    d. the solenoid

2. Second gear in a three-speed transmission has an approximate gear ratio of:

    a. 3 to 1
    b. 4 to 1
    c. 1 to 1
    d. 2 to 1

3. A torque multiplier is another name for a:

    a. transmission
    b. supercharger
    c. camshaft
    d. crankstaft

4. The type of gear which is the most superior of all the gears is the:

    a. spur gear
    b. face gear
    c. flank gear
    d. helical gear

5. Synchronized insert springs should be installed with:

    a. the free ends down
    b. both on one side
    c. the free ends up
    d. one on each side

37.11.02.02

6. Four-speed transmissions are most popular in cars with:

    a. high performance engines
    b. 411 rear end gear
    c. 422 rear end gear
    d. low compression engines

37.11.02.02. cont.

7. A material that is used in the construction of a transmission housing is:

   a. centrifugal alloy
   b. spring steel
   c. aluminum
   d. magnesium

8. Generally, all four forward gears in a four-speed transmission are:

   a. synchronized
   b. not driving the main shaft
   c. not backed with a synchronizer assembly
   d. on seperate shafts

9. The shafts of a transmission usually revlove on:

   a. roller or ball bearings
   b. blocking rings
   c. brass bearings
   d. gears

10. Mechanic A says too much clutch pedal free play may cause the clutch to drag when disengaged.

    Mechanic B says not enough clutch pedal free play may cause the clutch to slip when disengaged.

    a. A only
    b. B only
    c. Both A and B
    d. Neither A nor B

37.11.02.03

11. The planet pinions revlove around the:

    a. shift fork
    b. back gear
    c. ring gear
    d. sun gear

12. What shaft in the transmission drives the overdrive?

    a. input shaft
    b. output shaft
    c. reverse idler shaft
    d. counter shaft

13. The internal gear on an overdrive meshes with the:

    a. low gear
    b. planet pinions
    c. back gear
    d. cluster gear

37.11.02.03. cont.

14. An overdrive will give speed reduction for the engine of about what percent?

    a. 75%
    b. 50%
    c. 30%
    d. 60%

15. At about what speed will the overdrive kick in or become operative?

    a. 15 mph
    b. 20 mph
    c. 10 mph
    d. 30 mph

37.11.02.04

16. When the transmission shifts hard in all gears, it could be:

    a. counter gear anti-lash plate worn or damaged
    b. worn or damaged input shaft bearing
    c. wrong transmission lubricant
    d. defective input shaft bearing

17. To adjust excessive clutch pedal free travel, you would:

    a. use a stronger return spring
    b. adjust pedal linkage
    c. adjust shift linkage
    d. adjust clutch

18. After you have compiled the data of what is wrong with the transmission, you:

    a. make a mental note of it
    b. record a work order
    c. mark on a piece of paper
    d. take transmission out of car

19. Before working on a transmission, it is also advisable to do what?

    a. test drive
    b. use a black light
    c. clean transmission thoroughly
    d. read manual on assembly procedure

20. All of these can cause hard shifting into gear EXCEPT:

    a. the clutch not releasing completely
    b. a sliding gear loose on the main shaft splines
    c. worn synchronizers (blocker rings)
    d. gearshift linkage out of adjustment

37.11.02.05

21. In a 4-speed fully synchronized transmission, there is a clunking or knocking noise in only first and reverse.

    Mechanic A says that a broken tooth on the main drive gear could be the cause.

    Mechanic B says that a broken tooth on the countershaft (cluster) gear could be the cause.

    a. A only
    b. B only
    c. Either A or B
    d. Neither A nor B

22. What part must be marked before removal?

    a. U-joints
    b. transmission bolts
    c. throw-out bearing
    d. clutch dics

23. Before you can remove the transmission, you first must remove the:

    a. pressure plate
    b. throw-out bearing
    c. drive shaft
    d. input shaft

24. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:

    a. throw-out bearings
    b. input shaft
    c. pressure plate
    d. U-joint yoke

25. Failure to utilize a transmission jack during standard transmission removal will often result in what kind of injury?

    a. personal injury
    b. input shaft injury
    c. output shaft injury
    d. cam shaft injury

37.11.02.06

26. To remove the output shaft, you first have to remove the:

    a. low gear
    b. speedometer drive gear
    c. pressure plate
    d. shifter gear

37.11.02.06 cont.

27. When removing a synchronizer, it is important to keep what on each side of it to insure proper assembly?

   a. blocking rings
   b. shifting forks
   c. reverse idler gear
   d. counter shaft

28. If the transmission is noisy in neutral, chances are the:

   a. clutch is slipping, the gear teeth are stripped, or the fork is bent
   b. transmission is misaligned or the gears are worn
   c. linkage is out of adjustment or the speedometer gears are worn
   d. none of the above

29. Mechanic A says that installing a two-piece driveshaft, with the U-joints out of phase, may cause a driveline vibration.

   Mechanic B says that when you install new U-joints on a single piece driveshaft, care must be taken to properly phase the joints. Who is right?

   a. A only
   b. B only
   c. Both A and B
   d. Neither A or B

30. Although basic transmission designs are similar, the disassembly procedure:

   a. varies
   b. stays the same
   c. can be done on the car
   d. can only be done after the clutch removal

37.11.02.07

31. To remove a rear oil seal, you can do so by:

   a. taking the transmission out
   b. removing the drive shaft
   c. removing the pressure plate
   d. removing the throw-out bearing

32. When putting a front seal on a transmission, you have it facing:

   a. with lip facing the left of the housing
   b. with lip out
   c. with lip facing the right of the housing
   d. with lip in

37.11.02.07 cont.

33. You can replace a front oil seal by:

    a. removing throw-out bearing
    b. removing clutch
    c. removing transmission
    d. removing bell housing

34. It is possible to secure any degree of torque multiplication by:

    a. a heavier clutch
    b. a larger torque amplifier
    c. a larger engine
    d. a set of various gears

35. When replacing an input shaft bearing, you need to:

    a. put sealer on it
    b. lubricate it
    c. be sure it is completely dry
    d. be sure it is rippled on the surface

36. One method used to secure a counter shaft is to:

    a. use a roll pin
    b. use a set screw
    c. use a bolt and nut
    d. use an allen screw

37. The cluster gear is removed by removing the:

    a. output shaft assembly
    b. reverse idler shaft
    c. anti-lash plate
    d. counter shaft

38. If a gear has blocking ring surface, it must be:

    a. rounded
    b. uneven
    c. rippled
    d. smooth

39. The output shaft bearing surfaces should be smooth with:

    a. excessive racking when gears are on
    b. galling formations evident
    c. no evidence of galling
    d. excessive play where gears are on

40. The output shaft can be removed as a:

    a. cluster gear
    b. dual assembly
    c. triple assembly
    d. complete assembly

37.11.02.09

41. How many inserts does a synchronizer hub have?

    a. 2
    b. 3
    c. 1
    d. 4

42. The hub has slots in it so which of the following parts can be fitted into it?

    a. blocking ring
    b. sleeve
    c. inserts
    d. snap ring

43. When assemblying a synchronizer, you should lubricate with:

    a. transmission lube
    b. graphite
    c. light 10 weight oil
    d. light weight grease

44. On the hub you should check for wear on the inner:

    a. vane surface
    b. fine grooves
    c. splines
    d. coarse grooves

45. In order to unsure that the blocking rings are put on the hub the same way they were taken off, you should:

    a. write on them to tell which side is which
    b. draw a picture of them
    c. scribe them
    d. count the gear teeth on each side

37.11.02.10

46. When the counter shaft is in place, you should check end play with a:

    a. oscilloscope
    b. micrometer
    c. feeler gauge
    d. depth gauge

47. In first-speed gear, the power travels through the clutch shaft and the countershafts:

    a. drive gear, second gear, first gear, and shaft
    b. low gear, drive gear, low and reverse gear, and main shaft
    c. drive gear, low gear, low and reverse gear, and main shaft
    d. none of the above

37.11.02.10 cont.

48. When pins pass through the outer wall of the case, what should you do to prevent them from slipping out?

    a. glue pin to hole
    b. lubricate them
    c. lead hole in
    d. stake them

49. If drive-in expander plugs were removed:

    a. lubricate well and install
    b. install new ones
    c. dry thoroughly and install
    d. install again but do not use a sealer

50. New thrust washers, when assembling a transmission, will provide:

    a. and act as an oil seal
    b. tight fit with no end play
    c. proper end play
    d. a backing mechanism for the shaft

37.11.02.11

51. When adjusting the linkage on a car, the transmission is:

    a. in neutral
    b. out of the car
    c. just overhauled
    d. in high gear

52. It is essential that the shift cover have a:

    a. light coat of oil
    b. gasket
    c. light coat of grease
    d. heavy coat of grease

53. When installing a shift fork cover, the shift forks must align with:

    a. gear fork covers
    b. pilot bearings
    c. pressure plate
    d. countershaft

54. To install the shift cover, you must place the transmission in:

    a. neutral
    b. low
    c. high
    d. reverse

UNIT POST TEST ANSWER KEY: STANDARD TRANSMISSIONS (B)

37.11.02.01

1. D
2. D
3. A
4. D
5. D

37.11.02.02

6. A
7. C
8. A
9. A
10. B

37.11.02.03

11. D
12. B
13. B
14. C
15. D

37.11.02.04

16. C
17. B
18. B
19. A
20. C

37.11.02.05

21. B
22. A
23. C
24. D
25. A

37.11.02.06

26. B
27. A
28. B
29. A
30. A

37.11.02.07

31. B
32. D
33. C
34. D
35. B

37.11.02.08

36. A
37. D
38. D
39. C
40. D

37.11.02.09

41. B
42. C
43. A
44. C
45. C

37.11.02.10

46. C
47. C
48. D
49. B
50. C

37.11.02.11

51. A
52. B
53. A
54. A

Student: ______________________ File Code: 37.11.02.00.C2-1 (C)

Date: ______________________ Date Published: 6-9-77

Revised 9-12-78

Mountain-Plains Education &
Economic Development
Program, Inc.
Glasgow AFB, Montana 59231

UNIT POST TEST: STANDARD TRANSMISSIONS (C)

37.11.02.01

1. The control device that connects and disconnects the overdrive unit is:

   a. second gear
   b. the governor
   c. the relay
   d. the solenoid

2. A torque multiplier is another name for a:

   a. transmission
   b. supercharger
   c. camshaft
   d. crankshaft

3. Synchronized insert springs should be installed with:

   a. the free ends down
   b. both on one side
   c. the free ends up
   d. one on each side

4. The type of gear which is the most superior of all the gears is the:

   a. spur gear
   b. face gear
   c. flank gear
   d. helical gear

5. Second gear in a three-speed transmission has an approximate gear ratio of:

   a. 3 to 1
   b. 4 to 1
   c. 1 to 1
   d. 2 to 1

37.11.02.02

6. Generally, all four forward gears in a four-speed transmission are:

   a. synchronized
   b. not driving the main shaft
   c. not backed with a synchronizer assembly
   d. on seperate shafts

37.11.02.02 cont.

7. Mechanic A says too much clutch pedal free play may cause the clutch to drag when disengaged.

Mechanic B says not enough clutch pedal free play may cause the clutch to slip when engaged.

a. A only
b. B only
c. Both A and B
d. Neither A nor B

8. Four-speed transmissions are most popular in cars with:

a. high performance engines
b. 411 rear end gear
c. 422 rear end gear
d. low compression engines

9. The shafts of a transmission usually revolve on:

a. roller or ball bearings
b. blocking rings
c. brass bearings
d. gears

10. A material that is used in the construction of a transmission housing is:

a. centrifugal alloy
b. spring steel
c. aluminum
d. magnesium

37.11.02.03

11. The internal gear on an overdrive meshes with the:

a. low gear
b. planet pinions
c. back gear
d. cluster gear

12. At about what speed will the overdrive kick in or become operative?

a. 15 mph
b. 20 mph
c. 10 mph
d. 30 mph

13. The planet pinions revolve around the:

a. shift fork
b. back gear
c. ring gear
d. sun gear

37.11.02.03. cont.

14. An overdrive will give speed reduction for the engine of about what percent?

    a. 75%
    b. 50%
    c. 30%
    d. 60%

15. What shaft in the transmission drives the overdrive?

    a. input shaft
    b. output shaft
    c. reverse idler shaft
    d. counter shaft

37.11.02.04

16. When the transmission shifts hard in all gears, it could be:

    a. counter gear anti-lash plate worn or damaged
    b. worn or damaged input shaft bearing
    c. wrong transmission lubricant
    d. defective input shaft bearing

17. All of these can cause hard shifting into gear EXCEPT:

    a. the clutch not releasing completely
    b. a sliding gear loose on the main shaft splines
    c. worn synchronizers (blocker rings)
    d. gearshift linkage out of adjustment

18. After you have compiled the data of what is wrong with the transmission, you:

    a. make a mental note of it
    b. record a work order
    c. mark on a piece of paper
    d. take transmission out of car

19. To adjust excessive clutch pedal free travel, you would:

    a. use a stronger return spring
    b. adjust pedal linkage
    c. adjust shift linkage
    d. adjust clutch

20. Before working on a transmission, it is also advisable to do what?

    a. test drive
    b. use a black light
    c. clean transmission thoroughly
    d. read manual on assembly procedure

37.11.02.05

21. Failure to utilize a transmission jack during standard transmission removal will often result in what kind of injury?

    a. personal injury
    b. input shaft injury
    c. output shaft injury
    d. cam shaft injury

22. In a four-speed fully synchronized transmission, there is a clunking or knocking noise in only first and reverse.

    Mechanic A says that a broken tooth on the main drive gear could be the cause.

    Mechanic B says that a broken tooth on the countershaft (cluster) gear could be the cause.

    a. A only
    b. B only
    c. Either A or B
    d. Neither A nor B

23. What part must be marked before removal?

    a. U-joints
    b. transmission bolts
    c. throw-out bearings
    d. clutch disc

24. If the transmission fluid is not drained before removal, fluid will surely leak out upon removal of the:

    a. throw-out bearings
    b. input shaft
    c. pressure plate
    d. U-joint yoke

25. Before you can remove the transmission, you first must remove the:

    a. pressure plate
    b. throw-out bearing
    c. drive shaft
    d. input shaft

37.11.02.06

26. Although basic transmission designs are similar, the disassembly procedure:

    a. varies
    b. stays the same
    c. can be done on the car
    d. can only be done after the clutch removal

37.11.02.06 cont.

27. Mechanic A says that installing a two-piece driveshaft, with the U-joints out of phase, may cause a driveline vibration.

Mechanic B says that when you install new U-joints on a single piece driveshaft, care must be taken to properly phase the joints. Who is right?

a. A only
b. B only
c. Both A and B
d. Neither A nor B

28. To remove the output shaft, you first have to remove the:

a. low gear
b. speedometer drive gear
c. pressure plate
d. shifter shaft

29. If the transmission is noisy in neutral chances are the:

a. clutch is slipping, the gear teeth are stripped. or the fork is bent
b. transmission is misaligned or the gears are worn
c. linkage is out of adjustment or the speedometer gears are worn
d. none of the above

30. When removing a synchronizer, it is important to keep what on each side of it to insure proper assembly?

a. blocking rings
b. shifting forks
c. reverse idler gear
d. counter shaft

37.11.02.07

31. When replacing an input shaft bearing, you need to:

a. put sealer on it
b. lubricate it
c. be sure it is completely dry
d. be sure it is rippled on the surface

32. You can replace a front oil seal by:

a. removing throw-out bearing
b. removing clutch
c. removing transmission
d. removing bell housing

33. It is possible to secure any degree of torque multiplication by:

a. a heavier clutch
b. a larger torque amplifier
c. a larger engine
d. a set of various gears

37.11.02.07 cont

34. When putting a front seal on a transmission, you have it facing:

a. with lip facing the left of the housing
b. with lip out
c. with lip facing the right of the housing
d. with lip in

35. To remove a rear oil seal, you can do so by:

a. taking the transmission out
b. removing the drive shaft
c. removing the pressure plate
d. removing the throw-out bearing

37.11.02.08

36. The output shaft can be removed as a:

a. cluster gear
b. dual assembly
c. triple assembly
d. complete assembly

37. If a gear has a blocking ring surface, it must be:

a. rounded
b. uneven
c. rippled
d. smooth

38. The output shaft bearing surfaces should be smooth with:

a. excessive racking when gears are on
b. galling formations evident
c. no evidence of galling
d. excessive play where gears are on

39. One method used to secure a counter shaft is to:

a. use a roll pin
b. use a set screw
c. use a bolt and nut
d. use an allen screw

40. The cluster gear is removed by removing the:

a. output shaft assembly
b. reverse idler shaft
c. anti-lash plate
d. counter shaft

37.11.02.09

41. When assembling a synchronizer, you should lubricate with:

    a. transmission lube
    b. graphite
    c. light 10 weight oil
    d. light weight grease

42. In order to insure that the blocking rings are put on the hub the same way they were taken off, you should:

    a. write on them to tell which side is which
    b. draw a picture of them
    c. scribe them
    d. count the gear teeth on each side

43. How many inserts does a synchronizer hub have?

    a. 2
    b. 3
    c. 1
    d. 4

44. On the hub you should check for wear on the inner:

    a. vane surface
    b. fine grooves
    c. splines
    d. course grooves

45. The hub has slots in it so which of the following parts can be fitted into it?

    a. blocking ring
    b. sleeve
    c. inserts
    d. snap ring

37.11.02.10

46. New thrust washers, when assembling a transmission, will provide:

    a. and act as an oil seal
    b. tight fit with no end play
    c. proper end play
    d. a backing mechanism for the shaft

47. In first-speed gear, the power travels through the clutch shaft and the countershaft:

    a. drive gear, second gear, first gear, and shaft
    b. low gear, drive gear, low and reverse gear, and main shaft
    c. drive gear, low gear, low and reverse gear, and main shaft
    d. none of the above

37.11.02.10 cont

48. When pins pass through the outer wall of the case, what should you do to prevent them from slipping out?

    a. glue pin to hole
    b. lubricate them
    c. lead hole in
    d. stake them

49. When the counter shaft is in place, you should check end play with a:

    a. oscilloscope
    b. micrometer
    c. feeler gauge
    d. depth gauge

50. If drive-in expander plugs were removed:

    a. lubricate well and install
    b. install new ones
    c. dry thoroughly and install
    d. install again but do not use a sealer

37.11.02.11

51. To install the shift cover, you must place the transmission in:

    a. neutral
    b. low
    c. high
    d. reverse

52. When adjusting the linkage on a car, the transmission is:

    a. in neutral
    b. out of the car
    c. just overhauled
    d. in high gear

53. When installing a shift fork cover, the shift forks must align with:

    a. gear fork covers
    b. pilot bearing
    c. pressure plate
    d. countershaft

54. It is essential that the shift cover have a:

    a. light coat of oil
    b. gasket
    c. light coat of grease
    d. heavy coat of grease

UNIT POST TEST: STANDARD TRANSMISSION (C)

1. D
2. A
3. D
4. D
5. D
6. B
7. B
8. A
9. A
10. C
11. B
12. D
13. D
14. C
15. B
16. A
17. C
18. B
19. B
20. C
21. A
22. B
23. A
24. D
25. C
26. A
27. A
28. B
29. [illegible]
30. A
31. B
32. C
33. D
34. D
35. B
36. D
37. D
38. C
39. A
40. D
41. A
42. C
43. B
44. C
45. C
46. C
47. C
48. D
49. C
50. B
51. A
52. A
53. A
54. B

Student: ____________________ File Code: 37.11.02.00.B1-5

Date: ____________________ Date Published: 3/10/76

Mountain-Plains Education &
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Program, Inc.
Glasgow AFB, Montana 59231

Family Pay Number: __________ Sex: M F (Circle 1)

UNIT PERFORMANCE TEST: STANDARD TRANSMISSION

OBJECTIVE 1:

Troubleshoot transmission as per checklist.

OBJECTIVE 2:

Remove and disassemble transmission.

OBJECTIVE 3:

Repair transmission as per checklist.

OBJECTIVE 4:

Reassemble transmission as per checklist.

TASK:

The student will be assigned a car with a standard transmission with which he must troubleshoot, remove, disassemble, inspect, repair, and reassemble the transmission.

ASSIGNMENT:

CONDITIONS:

The student may use only those materials and tools provided for the test and will take the test in an auto shop.

RESOURCES:

Auto with standard transmission
Jacks
Jack stands
Service and parts manuals
New parts as needed
Transmission lubricant
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

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Glasgow AFB, Montana 59231

Student: ____________________

Date: ____________________

File Code: 37.11.02.00.B1-5

Date Published: 3/10/76

Family Pay Number: __________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Checks clutch for trouble.		
Criterion: Follows service manual procedures for troubleshooting a clutch.		
2. Check transmission for hard shifting.		
Criterion: Compares to manufacturer's specifications.		
3. Check transmission for clash in shifting.		
Criterion: Compares to manufacturer's specifications.		
4. Check transmission for noise in forward speed.		
Criterion: Compares to Manufacturer's specifications.		
5. Check tranmission for noise in reverse.		
Criterion: Compares to manufacturer's specifications.		
6. Check transmission for slipping out of gear.		
Criterion: Compares to manufacturer's specifications.		
7. Check tranmission for noise in neutral.		

(Checklist continued)

	CRITERION Met	 Not Met
Criterion: Compares to manufacturer's specifications.		
Objective 2:		
8. Removes transmission safely.		
Criterion: Uses safety devices and does not damage transmission.		
9. Disassembles transmission.		
Criterion: Follows service manual procedures and cleans		
all parts.		
Objective 3:		
10. Repairs transmission.		
Criterion: Compares all parts to manufacturer's		
specifications. Replaces defective parts.		
Objective 4:		
11. Assembles transmission.		
Criterion: Follows service manual procedure.		
12. Installs transmission.		
Criterion: Transmission and drive line correctly		
assembled and lubricated.		
13. Installs and adjusts shift linkage.		
Criterion: Transmission shifts and operates to manufacturer's		
specifications.		

	CRITERION	
	Met	Not Met
14. Completes job in allotted time.		
Criterion: Meets flat rate time on assigned vehicle.		
The student must successfully complete 12 out of 14 line items		
to achieve a passing score.		

File Code: 37.11.03.00.B1-1

Date Published: 3/10/76

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Glasgow AFB, Montana 59231

Learning Experience Guide

UNIT: AUTOMATIC TRANSMSSSIONS

RATIONALE:

The fundamentals in this unit will familiarize you with the principles and components of automatic transmissions.

PREREQUISITES:

None

OBJECTIVE:

Recognize the components and operation of automatic transmissions.

RESOURCES:

Printed Materials

Auto Service and Repair. Martin W. Stockel. Goodheart-Willcox Company, Inc.
Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.

Audio/Visuals

Video Tape: Torque Converter. Mountain-Plains Education and Economic Development Company, Inc.

Equipment

Video-tape player.

GENERAL INSTRUCTIONS:

This unit consists of seven Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

(1) Read the first assigned Learning Activity Package (LAP).
(2) Begin and complete the first assigned LAP.
(3) Take and score the LAP test.
(4) Turn in the LAP test answer sheet.
(5) Determine the reason for any missed items on the LAP test.

Principal Author(s): C. Schramm/W. Osland

GENERAL INSTRUCTIONS (CONT.)

(6) Proceed to and complete the next assigned LAP in the unit.
(7) Complete all required LAPs for the unit by following steps 3 through 6.
(8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
(9) Take the unit tests as described in the Unit LEG "Evaluation Procedures". This Unit has no performance test.
(10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

.01 Fluid Couplings
.02 Planetary Gears
.03 Pumps and Valves
.04 Modulator
.05 Leaks and Fluid
.06 Special Tools
.07 Towing Car Equipped with Automatic Transmission

EVALUATION PROCEDURE:

When pretesting:

1. Take the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.

When post testing:

1. Take the multiple-choice unit post test.
2. There is no performance test for this unit.

Score at least 80% correct on the unit post test.

FOLLOW-THROUGH:

Discuss with the instructor the next unit to complete.

Go to the first Learning Activity Package (LAP) listed on your SPR.

Student: ______________________ **File Code:** 37.11.03.00.B1-2

Date: ______________________ **Date Published:** ______

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UNIT PRETEST: AUTOMATIC TRANSMISSIONS

37.11.03.01

1. What unit in an automatic transmission eliminates the conventional clutch and pedal as used in the standard transmissions?

   a. Fluid coupling.
   b. Stator.
   c. a Torus.
   d. Governor valve.

2. A fluid coupling looks like:

   a. half a doughnut.
   b. a hose with a female coupling on the end.
   c. a hose with a male coupling on the end.
   d. a gear with helical teeth.

*3. What is the principal difference between a fluid coupling and a torque convertor?

   a. The torque convertor transmits engine torque but can't multiply it.
   b. The fluid coupling transmits all engine torque but can't multiply it.
   c. The fluid coupling can't transmit engine torque but can multiply it.
   d. The torque convertor can't transmit engine torque but multiplies it.

4. The convertor vanes are shaped in what way?

   a. Corrigated.
   b. Straight.
   c. Square.
   d. Curved.

5. A torus is:

   a. a complete fluid coupling.
   b. half of a fluid coupling.
   c. another name for a stator.
   d. another name for a torque convertor.

---

*(From Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 250, #10.)

37.11.03.02.

6. The planetary pinions rotate around the:

   a. sun gear.
   b. internal gear.
   c. torque convertor.
   d. stator.

7. For large torque increase what do the planetary pinions rotate around?

   a. The internal gear.
   b. The sun gear.
   c. The stator.
   d. The torque convertor.

8. For small torque increase the planetary pinions rotate around the:

   a. internal gear.
   b. sun gear.
   c. stator.
   d. fluid coupling.

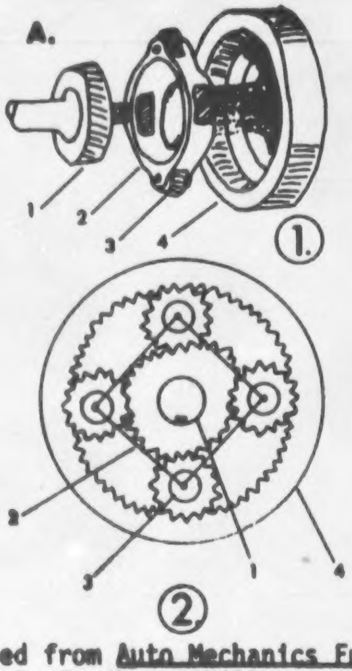
9. In diagram A*, what is #1?

   a. Planetary pinions.
   b. Sun gear.
   c. Internal gear.
   d. Stator.

10. In diagram A, what is #3?

   a. Internal gear.
   b. Planetary carrier.
   c. Planetary pinions.
   d. Fluid coupling.

A.



*(Adapted from Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 231, Fig. 12-27.)

37.11.03.03.

11. What is a servo?

    a. Universal joint.
    b. Brake band.
    c. Check valve.
    d. A hydraulic piston.

12. A servo operates a:

    a. fluid coupling.
    b. universal joint.
    c. torque convertor.
    d. brake band.

13. An apply piston in a servo is used to:

    a. disengage the actuating lever.
    b. apply light pressure.
    c. apply heavy pressure.
    d. release pressure.

14. What releases the discs in a clutch when the oil pressure drops?

    a. Linkage.
    b. Piston.
    c. A heavy spring.
    d. Fluid pressure.

15. What valve has to open just before the shifter valve does?

    a. Manual valve.
    b. Governor valve.
    c. Relief valve.
    d. Torus feed valve.

37.11.03.04.

16. A modulator uses what to operate?

    a. Check valve.
    b. Engine oil pressure.
    c. Engine heat.
    d. Engine vacuum.

37.11.03.04. cont.

17. A modulator consists of a container separated into two areas by a:

    a. diaphragm.
    b. plate.
    c. valve.
    d. seal.

18. One type of modulator works on:

    a. altitude air pressure.
    b. engine heat.
    c. cam shaft.
    d. check valve.

19. What type of modulator has a collapsing bellows in it?

    a. boost valve type.
    b. engine vacuum.
    c. altitude pressure type.
    d. check valve type.

20. The collapsing force in one type of modulator is greatest at:

    a. low engine vacuum.
    b. high elevation.
    c. sea level.
    d. low engine heat.

37.11.03.05.

21. Transmission fluid level should be kept:

    a. on the full marks.
    b. between add and full marks.
    c. slightly below the add mark.
    d. slightly above the full mark.

22. You check transmission fluid level when the fluid is at:

    a. it doesn't matter what temperature.
    b. cold operating temperature.
    c. hot operating temperature.
    d. normal operating temperature.

23. When checking fluid level the shift lever should be in what position?

    a. in reverse with brakes applied.
    b. drive, low with brakes applied.
    c. drive high with brakes applied.
    d. park or neutral.

37.11.03.05. cont.

24.

25. To determine what type of leak you have under your car, you can use a:

    a. light coat of dust on pan.
    b. fluorescent light.
    c. flour spray.
    d. black light.

37.11.03.06.

26. To adjust a TV lever, you must use what tool?

    a. sockets.
    b. rear servo gauge.
    c. sliding T-bar.
    d. throttle lever bending tool.

27. To check the adjustment of the downshift switch, you use a:

    a. torque wrench.
    b. gauge rod and test light.
    c. sockets.
    d. double square socket.

28. In doing a stall test, you would use a:

    a. oscilloscope.
    b. dial indicator.
    c. tachometer.
    d. vacuum gauge.

29. What do you use to adjust the tightening band adjusting screw on an automatic transmission?

    a. throttle lever gauge.
    b. a hex bit.
    c. .250 in gauge block.
    d. a preset torque wrench.

30. A vacuum controlled primary throttle valve can be checked by:

    a. applying a vacuum gauge to the system.
    b. applying a controlled vacuum unit to system.
    c. using a front servo gauge
    d. using a rear servo gauge.

37.11.03.07.

31. Most cars with automatic transmission can be towed how many miles in neutral at speeds below 45 mph?

    a. 25 miles.
    b. 10 miles.
    c. 50 miles.
    d. 100 miles.

32. If the propeller shaft and transmission are not in sound condition, you would tow by:

    a. raising rear wheels.
    b. towing at a speed less than 25 mph.
    c. disconnecting the driveshaft.
    d. putting transmission in neutral.

33. Cars with torsion-level suspension system can not be towed until:

    a. the linkage is disconnected.
    b. the leveler control switch is off.
    c. the drive shaft is disconnected.
    d. the car is in neutral.

34. On some cars with automatic transmissions, the maximum distance they can be towed is:

    a. 10 miles.
    b. 0 miles.
    c. 25 miles.
    d. 50 miles.

35. You should not tow a car with an automatic transmission when:

    a. you can't put the transmission in drive.
    b. you can't remove the driveshaft.
    c. there is no transmission fluid.
    d. you can't raise the rear wheels.

PRETEST

UNIT TEST ANSWER SHEET

Occupational Area: ______________________

File Code: 37.11.03.00.B1-2

Name: ______________________

Family Pay Number ______________________ Sex M F (Circle 1)

ANSWERS

7.11.03.01	1.	A	37.11.03.05	21.	B	41.	
	2.	A		22.	D	42.	
	3.	B		23.	D	43.	
	4.	D		24.	D	44.	
	5.	A		25.	D	45.	
7.11.03.02	6.	A	37.11.03.06	26.	D	46.	
	7.	A		27.	B	47.	
	8.	B		28.	C	48.	
	9.	B		29.	D	49.	
	10.	C		30.	B	50.	
.11.03.03	11.	D	37.11.03.07	31.	C	51.	
	12.	D		32.	A	52.	
	13.	C		33.	B	53.	
	14.	C		34.	B	54.	
	15.	B		35.	C	55.	
.11.03.04	16.	D		36.		56.	
	17.	A		37.		57.	
	18.	A		38.		58.	
	19.	C		39.		59.	
	20.	C		40.		60.	

File Code: 37.11.03.01.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: Fluid Couplings

OBJECTIVE:

Identify the components and describe the operation of fluid couplings.

EVALUATION PROCEDURE:

Score at least 80% correct on the LAP study questions.

Successful completion of this LAP is determined by correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Planetary Gears" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

Videotape: Torque Converter, Mountain-Plains.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 12, pages 235-242.
3. View the film, Torque Converter.
4. On separate paper, answer questions on page 260, number 1 and 8 through 22
5. Give the answer sheet to the instructor for evaluation.
6. Return the text and film.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.03.02.B1-0

Date Published: 3/10/76

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Planetary Gears

OBJECTIVE:

Recognize the components and proper operation of the planetary gear set.

EVALUATION PROCEDURE:

Score at least 80% correct on the LAP study questions and 80% correct on LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 12, pages 242-244.
3. On separate paper, answer questions on page 260, number 2 through 7.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Take the LAP test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

37.11.03.02.B1-2

Student: ______________________ File Code: 37.11.03.02.B1-2

Date: ______________________ Date Published: 3/10/76

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LAP TEST: FLUID COUPLINGS/PLANETARY GEARS

37.11.03.01.

*1. What is the principal difference between a fluid coupling and a torque convertor?

a. The fluid coupling transmits all engine torque but can't multiply it.
b. The torque convertor transmits engine torque but can't multiply it.
c. The fluid coupling can't transmit engine torque but can multiply it.
d. The torque convertor can't transmit engine torque but multiplies it.

2.

3. The convertor vanes are shaped in what way?

a. square
b. curved
c. corrugated
d. straight

4. The driving torus is held by the:

a. drive shaft.
b. engine block.
c. flywheel.
d. clutch plate.

5. The shape of the vanes in a fluid coupling are:

a. curved.
b. straight.
c. corrugated.
d. boxed.

* (From Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 250, #10.)

37.11.03.02.

6. The planetary pinions rotate around the:

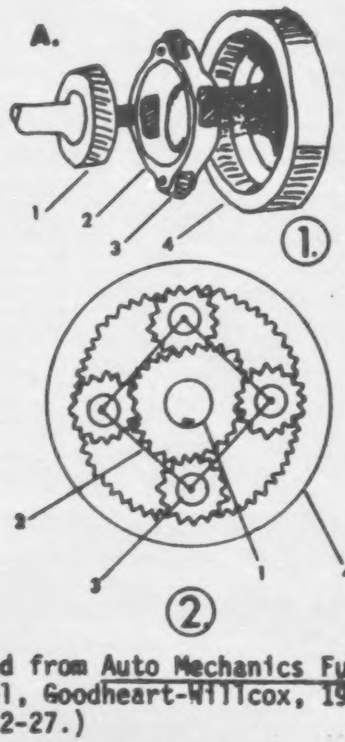
   a. internal gear.
   b. torque convertor.
   c. sun gear.
   d. stator.

7. For large torque increase what do the planetary pinions rotate within?

   a. the stator
   b. the torque converter
   c. the sun gear
   d. the internal gear

8. In diagram A*, what is #1?

   a. internal gear
   b. stator
   c. planetary pinions
   d. sun gear



*(Adapted from Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 231, Fig. 12-27.)

9. For small torque increase the planetary pinions rotate around the:

   a. sun gear.
   b. fluid coupling.
   c. internal gear.
   d. stator.

10. In diagram A, what is #4?

    a. planetary pinions
    b. internal gear
    c. sun gear
    d. planetary carrier

37.11.03.01.B1-2
37.11.03.02.B1-2

LAP TEST ANSWER KEY: FLUID COUPLINGS/PLANETARY GEARS

LAP 01

1. a
[redacted]
3. b
4. c
5. b

LAP 02

6. c
7. d
8. d
9. a
10. b

File Code: 37.11.03.03.B1-0

Date Published: 3/10/76

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______

Date: ______

PERFORMANCE ACTIVITY: Pumps and Valves

OBJECTIVE:

Recognize the operation of automatic transmission pumps and valves.

EVALUATION PROCEDURE:

Score at least 80% on the study questions.

Correctly answer at least 8 out of 10 items on a multiple-choice test that is combined with "Modulator" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 12, pages 244-250.
3. On separate paper, answer questions on page 260, number 23 through 30.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.03.04.B1-0

Date Published: 3/10/76

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Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Modulator

OBJECTIVE:

Recognize the proper operation of the vacuum modulator.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions.

80% accuracy on the LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 12, pages 250-260.
3. On separate paper, answer questions on page 260, number 31 through 37.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.03.03.B1-2
37.11.03.04.B1-2

Date: ______________________ Date Published: 3/10/76

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LAP TEST: PUMPS AND VALVES/MODULATOR

37.11.03.03.

1. One of the two types of oil pumps used in an automatic transmission is the:
    a. schematic type.
    b. governor type.
    c. servo type.
    d. internal-external type.

2. What releases the discs in a clutch when the oil pressure drops?
    a. fluid pressure
    b. linkage
    c. piston
    d. a heavy spring

3. One of the two types of oil pumps used in an automatic transmission is the:
    a. variable output type.
    b. disc pump type.
    c. cooler type.
    d. stator type.

4. A servo operates a:
    a. universal joint.
    b. fluid coupling.
    c. brake band.
    d. torque convertor.

5. What valve has to open just before the shifter valve does?
    a. governor valve
    b. manual valve
    c. torus feed valve
    d. relief valve

37.11.03.04.

6. A modulator operates on:

   a. engine vacuum.
   b. check valve.
   c. engine oil pressure.
   d. engine heat.

7. What type of modulator has a collapsing bellows in it?

   a. boost valve type
   b. altitude pressure type
   c. check valve type
   d. engine vacuum

8. A modulator consists of a container separated into two areas by a:

   a. seal.
   b. diaphragm.
   c. valve.
   d. plate.

9. The collapsing force in one type of modulator is greatest at:

   a. low engine heat.
   b. sea level.
   c. high elevation.
   d. low engine vacuum.

10. One type of modulator works on:

    a. engine heat.
    b. a camshaft.
    c. a check valve.
    d. an altitude air pressure.

LAP TEST ANSWER KEY: PUMPS AND VALVES/MODULATOR

LAP 03

1. d
2. d
3. a
4. c
5. a

LAP 04

6. a
7. b
8. b
9. b
10. d

File Code: 37.11.03.05.B1-0

Date Published: 3/10/76

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Learning Activity Package

Student: __________

Date: __________

PERFORMANCE ACTIVITY: Leaks and Fluid

OBJECTIVE:

Recognize qualities of automatic transmission fluids and proper procedures to detect leaks.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions.

Correctly answer at least 8 out of 10 items on a multiple-choice test that is combined with "Towing Car Equipped with Automatic Transmission" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Service and Repair, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Service and Repair and a quiet place to study.
2. Study Chapter 26, page 26-1 to 26-9.
3. On separate paper, answer questions on page 26-23 and 26-24, number 3 through 16.
4. Give the answer sheet to the instructor.
5. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.03.06.B1-0

Date Published: 3/10/76

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Special Tools

OBJECTIVE:

Recognize the proper use of special automatic transmission tools.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions.

Correctly answer at least 8 out of 10 items on a multiple-choice test that is combined with "Towing Car Equipped with Automatic Transmission" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Service and Repair, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Service and Repair and a quiet place to study.
2. Read "Tools are Important", page 26-9 through "Neutral Safety Switch", page 26-12.
3. On separate paper, answer the questions on page 26-24, number 17 through 28.
4. Study figure 26-16 on page 26-9.
5. On separate paper, describe the use of each of the 30 tools pictured in figure 26-16 on page 26-9.
6. Give the answer sheet to the instructor for evaluation.
7. Return the text.
8. Proceed to the next LAP.

Principal Author(s):

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Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Towing Car Equipped with Automatic Transmission

OBJECTIVE:

Recognize and follow the correct procedure for towing an automobile equipped with an automatic transmission.

EVALUATION PROCEDURE:

Score at least 80% correct on the questions in this LAP and 80% accuracy on LAP test.

RESOURCES:

Auto Service and Repair, Stockel,

PROCEDURE:

1. Obtain a copy of Auto Service and Repair and a quiet place to study.
2. Study "Pushing Car to Start" and "Towing Disabled Car With An Automatic Transmission" on page 26-20.
3. On separate paper, answer questions 37 and 38 on page 26-24.
4. Read "Towing Cars with Automatic Transmissions" and "Towing Procedures for Cars with Automatic Transmissions." (attached)
5. Ask the instructor for an assignment of a transmission type.
6. With the assignment, answer the following questions on separate paper.
   a. Describe the procedure for towing the car 10 miles.
   b. Describe the procedure for towing the car 500 miles.
7. Give the answer sheets to the instructor for evaluation.
8. Return the text.
9. Take the LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.03.05-.07 B1-2

Date: ______________________ Date Published: 3-10-76

Revised: 8-14-78

Mountain-Plains Education &
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LAP TEST: SPECIAL TOOLS/LEAKS AND FLUID/TOWING CAR EQUIPPED WITH AUTOMATIC TRANSMISSION

37.11.03.06

1. To check the adjustment of the downshift switch, you use:

   a. a guage rod and test light.
   b. sockets.
   c. a double square socket.
   d. a torque wrench.

2. What do you use to adjust the tightening and adjusting screw on an automatic transmission?

   a. a preset torque wrench.
   b. .250 in gauge block.
   c. a hex bit.
   d. throttle lever gauge.

3. A vacuum controlled primary throttle valve can be checked by:

   a. using a front servo gauge.
   b. using a rear servo gauge.
   c. applying a controlled vacuum unit to system.
   d. applying a vacuum gauge to the system.

37.11.03.05

4. High oil level (above full mark):

   a. can help lower operating temperature of the transmission.
   b. improves the lubrication of the transmission.
   c. can cause faulty band and clutch operation because of the foaming of the oil.
   d. has little, if any, affect upon the transmission.

5. When checking fluid level, the shift lever should be in what position?

   a. in dirve (low) with brakes applied.
   b. in reverse with brakes applied.
   c. in park or neutral or as specified by manufacturer.
   d. in drive (high) with brakes applied.

*6. Automatic transmissions require special fluid. It is identified by:

a. AQ-TAF.
b. AQ-A.
c. BD-A.
d. AQ-ATF.

7. Transmission fluid level should be kept:

a. between add and full marks.
b. slightly above the full mark.
c. slightly below the add mark.
d. on the full marks.

8. You check transmission fluid level when the fluid is at:

a. it doesn't matter what temperature.
b. cold operating temperature.
c. normal operating temperature.
d. hot operating temperature.

37.11.03.07

9. A car with an automatic transmission (since mid 1960's):

a. cannot be push started.
b. can be push started at speeds above 50 mph..
c. can be push started with the selector in low range only.
d. can be push started in drive range.

10. A car that has an automatic transmission can be towed at any speed by:

a. putting car in drive so transmission can be lubricated.
b. disconnecting linkage.
c. removing the drive shaft.
d. putting car in neutral.

*(Adapted from Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1969, page 231, Figure 12-27).

LAP TEST ANSWER KEY: SPECIAL TOOLS/LEAKS AND FLUIDS/TOWING CAR EQUIPPED WITH AUTOMATIC TRANSMISSION

LAP .05

1. A
2. A
3. C

LAP .06

4. C
5. C
6. D
7. A
8. C

LAP .07

9. A
10. C

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Student: ______________________
File Code: 37.11.03.00.C1-2 (A)
Date: ______________________
Date Published: 11/21/77
Revised: 4-11-78

UNIT POST TEST: AUTOMATIC TRANSMISSIONS

37.11.03.01

1. What unit in an automatic transmission eliminates the conventional clutch and pedal as used in the standard transmission?
   a. fluid coupling
   b. stator
   c. a Torus
   d. governor valve

2. A fluid coupling looks like:
   a. a hose with a female coupling on the end
   b. a hose with a male coupling on the end
   c. a gear with helical teeth
   d. half a doughnut

3. The converter vanes are shaped in what way?
   a. square
   b. curved
   c. corrugated
   d. straight

*4. What is the principal difference between a fluid coupling and a torque converter?
   a. the fluid coupling transmits all engine torque but can't multiply it
   b. the fluid coupling can't transmit engine torque but can multiply it
   c. the torque converter transmits engine torque but can't multiply it
   d. the torque converter can't transmit engine torque but multiplies it

5. The shape of the vanes in a fluid coupling is:
   a. curved
   b. boxed
   c. straight
   d. corrugated

---

*(From Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 250, #10.)

37.11.03.02

6. For large torque increase what do the planetary pinions rotate around?

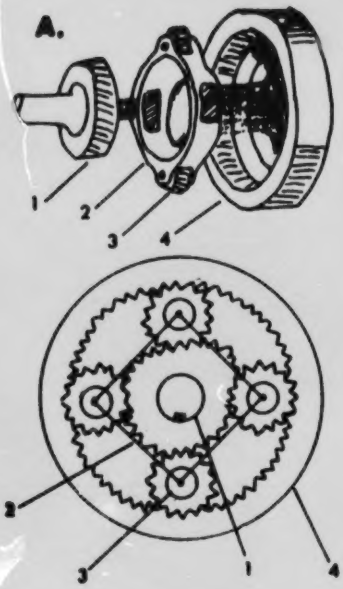
    a. the torque converter
    b. the stator
    c. the sun gear
    d. the internal gear

7. In Diagram A,* what is #2?

    a. internal gear
    b. sun gear
    c. planet carrier
    d. torque convertor

8. In Diagram A, what is #3?

    a. planet pinions
    b. fluid coupling
    c. planet carrier
    d. internal gear



*(Adapted from Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 231, Figure. 12-27.)

9. In Diagram A, what is #4?

    a. internal gear
    b. planet pinions
    c. planet carrier
    d. sun gear

10. For small torque increase, the planetary pinions rotate around the:

    a. stator
    b. fluid coupling
    c. sun gear
    d. internal gear

37.11.03.03

11. What releases the discs in a clutch when the oil pressure drops?

    a. a heavy spring
    b. fluid pressure
    c. piston
    d. linkage

12. One of the two types of oil pumps used in an automatic transmission is the:

    a. cooler type
    b. variable output type
    c. stator type
    d. disc pump type

13. What is a servo?

    a. hydraulic piston
    b. check valve
    c. brake band
    d. universal joint

14. One of the two types of oil pumps used in an automatic transmission is the:

    a. servo type
    b. governor type
    c. internal-external type
    d. schematic type

15. A servo operates a:

    a. universal joint
    b. brake band
    c. fluid coupling
    d. torque convertor

37.11.03.04

16. The collapsing force in one type of modulator is greatest at:

    a. sea level
    b. low engine vacuum
    c. low engine heat
    d. high elevation

37.11.03.04 (continued)

17. The collapsing force in one type of modulator lessons:

    a. at low elevation
    b. at sea level
    c. at high elevation
    d. at high engine vacuum

18. A modulator uses what to operate?

    a. engine vacuum
    b. check valve
    c. engine heat
    d. engine oil pressure

19. The modulator provides accurate control over the:

    a. pressure booster valve
    b. compensator valve
    c. throttle valve
    d. release valve

20. What type of modulator has a collapsing bellow in it?

    a. boost valve type
    b. check valve type
    c. engine vacuum
    d. altitude pressure type

37.11.03.05

21. To determine what type of leak you have under your car you can use a:

    a. fluorescent light
    b. light coat of dust on pan
    c. black light
    d. flour spray

22. You check transmission fluid level when the fluid is at:

    a. normal operating temperature
    b. it doesn't matter what temperature
    c. hot operating temperature
    d. cold operating temperature

23. When confronted with an inoperative automatic transmission, the first action should be to:

    a. change the fluid
    b. check the fluid level
    c. disconnect the drive shaft
    d. disconnect the shift linkage

37.11.03.05 (continued)

24. In the event the automatic transmission is overfilled, one can most likely expect:

    a. a clogged oil suction screen
    b. the transmission to whine in neutral
    c. oil to be forced out the filler tube
    d. harsh upshifts at light throttle

25. The optimum level of transmission fluid is:

    a. between the add and full marks
    b. right on the full mark
    c. right on the add mark
    d. just above the full mark

37.11.03.06

26. What do you use to adjust the band adjusting screw on an automatic transmission?

    a. a preset torque wrench
    b. a hex bit
    c. .250 in gauge block
    d. throttle lever gauge

27. A vacuum controlled primary throttle valve can be checked by:

    a. using a front servo gauge
    b. applying a controlled vacuum unit to system
    c. using a rear servo gauge
    d. applying a vacuum gauge to the system

28. The engine mounts can affect what on the transmission?

    a. stator
    b. oil pump
    c. fluid coupling
    d. shift linkage

29. What should be used to check the adjustment of the downshift switch of an automatic transmission?

    a. torque wrench
    b. socket wrench
    c. gauge rod and test light
    d. double square socket

30. Gauges used for pressure checks on an automatic transmission usually have a capacity of:

    a. 300 PSI
    b. 200 PSI
    c. 500 PSI
    d. 30 PSI

37.11.03.07

31. When adjusting the control linkage of an automatic transmission it is not necessary to:

    a. check the anti-stall dashpot
    b. set the engine idle speed
    c. refer to any manuals
    d. remove the selector lever from the steering column

32. When there is a consistant loss of automatic transmission fluid but no evidence of external leaks it may be necessary to replace the:

    a. vacuum modulator valve
    b. drive shaft torque tube
    c. power servo assembly
    d. internal filter

33. To replace a defective out put shaft seal in an automatic transmission:

    a. check the counterbore for defects
    b. drain the fluid
    c. disconnect the power train
    d. remove the propeller shaft U-joint yoke.

34. The function of the vacuum modulator is to:

    a. vary the shift points according to load requirements
    b. force a down-shift for passing
    c. sense changes in altitude
    d. allow the car to be push-started when the engine stalls and loses manifold vacuum

35. If a car with an automatic transmission is operating normally but breaks a timing chain and needs to be towed in excess of 100 miles, it can be towed:

    a. safely at moderate speeds
    b. safely at moderate speeds if the fluid level is up
    c. safely if the rear wheels are raised or the drive shaft removed
    d. if the rear wheels are raised and the drive shaft removed

37.11.03.00.C1-2 (A)

UNIT POST TEST ANSWER KEY: AUTOMATIC TRANSMISSIONS

LAP 11.03.01

1. A
2. D
3. B
4. A
5. C

LAP 11.03.02

6. D
7. C
8. A
9. A
10. C

LAP 11.03.03

11. A
12. B
13. A
14. C
15. B

LAP 11.03.04

16. A
17. C
18. A
19. C
20. D

LAP 11.03.05

21. C
22. A
23. B
24. C
25. A

LAP 11.03.06

26. A
27. B
28. D
29. C
30. A

LAP 11.03.07

31. D
32. A
33. ~~B~~ D
34. A
35. C

Student: ____________________ File Code: 37.11.03.00.C1-2(B)

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UNIT POST TEST: AUTOMATIC TRANSMISSIONS (B)

37.11.03.C1

1. The shape of the vanes in a fluid coupling is:

   a. curved
   b. boxed
   c. straight
   d. corrugated

2. *What is the principal difference between a fluid coupling and a torque convertor?

   a. the fluid coupling transmits all engine torque but can't multiply it.
   b. the fluid coupling can't transmit engine torque but can multiply it.
   c. the torque convertor transmits engine torque but can't multiply it.
   d. the torque convertor can't transmit engine torque but mulitplies it.

3. The convertor vanes are shaped in what way?

   a. square
   b. curved
   c. corrugated
   d. straight

4. A fluid coupling looks like:

   a. a hose with a female coupling on the end.
   b. a hose with a male coupling on the end.
   c. a gear with helical teeth.
   d. half a doughnut.

5. What unit in an automatic transmission eliminates the conventional clutch and pedal as used in the standard transmission?

   a. fluid coupling
   b. stator
   c. a Torus
   d. governor valve

*(From Auto Mechanics Fundamentals, Stockel, Goodheart-Wilcox, 1969, p. 250, #10.)

37.11.03.02

6. For small torque increase, the planetary pinions rotate around the:

   a. stator
   b. fluid coupling
   c. sun gear
   d. internal gear

7. In diagrcm A., what is #4?

   a. internal gear
   b. planet pinions
   c. planet carrier
   d. sun gear

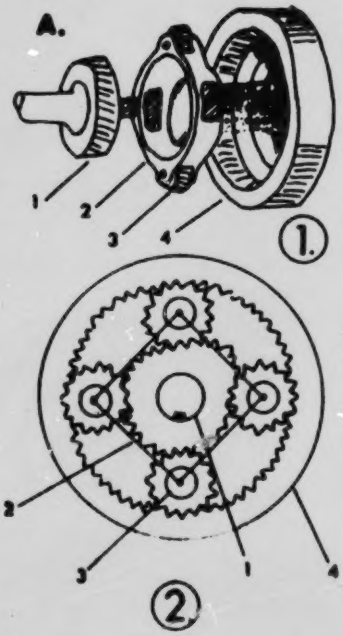
8. In diagram A., what is #3?

   a. planet pinions
   b. fluid coupling
   c. planet carrier
   d. internal gear

9. In Diagram A,* what is #2?

   a. internal gear
   b. sun gear
   c. planet carrier
   d. torque convertor

A.



*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Willcox, 1969, p. 231, Fig. 12-27.)

10. For large torque increase what do the planetary pinions rotate around?

   a. the torque convertor
   b. the stator
   c. the sun gear
   d. the internal gear

37.11.03.03

11. A servo operates a:

   a. universal joint
   b. brake band
   c. fluid coupling
   d. torque convertor

12. One of the two types of oil pumps used in an automatic transmission is the:

   a. servo type
   b. governor type
   c. internal-external type
   d. schematic type

37.11.03.03 cont.

13. What is a servo?

    a. a hydraulic piston
    b. check valve
    c. brake band
    d. universal joint

14. One of the two types of oil pumps used in an automatic transmission is the:

    a. cooler type
    b. variable output type
    c. stator type
    d. disc pump type

15. What releases the discs in a clutch when the oil pressure drops?

    a. a heavy spring
    b. fluid pressure
    c. piston
    d. linkage

37.11.03.04

16. What type of modulator has a collapsing bellow in it?

    a. boost valve type
    b. check valve type
    c. engine vacuum
    d. altitude pressure type

17. The modulator provides accurate control over the:

    a. pressure booster valve
    b. compensator valve
    c. throttle valve
    d. release valve

18. A modulator uses what to operate?

    a. engine vacuum
    b. check valve
    c. engine heat
    d. engine oil pressure

19. The collasping force in one type of modulator lessons:

    a. at low elevation
    b. at sea level
    c. at high elevation
    d. at high engine vacuum

37.11.03.04. cont.

20. The collasping force in one type of modulator is greatest at:

    a. sea level
    b. low engine vacuum
    c. low engine heat
    d. high elevation

37.11.03.05

21. The optimum level of transmission fluid is:

    a. between the add and full marks
    b. right on the full mark
    c. right on the add mark
    d. just above the full mark

22. You check transmission fluid level when the fluid is:

    a. normal operating temperature
    b. it doesn't matter what temperature
    c. hot operating temperature
    d. cold operating temperature

23. To determine what type of leak you have under your car you can use a:

    a. fluorescent light
    b. light coat of dust on pan
    c. black light
    d. flour spray

24. When confronted with an inoperative automatic transmission, the first action should be to:

    a. change the fluid
    b. check the fluid level
    c. disconnect the drive shaft
    d. disconnect the shift linkage

25. In the event the automatic transmission is overfilled, one can most likely expect:

    a. a clogged oil suction screen
    b. the transmission to whine in neutral
    c. oil to be forced out the filler tube
    d. harsh upshifts at light throttle

37.11.03.06

26. Gauges used for pressure checks on an automatic transmission usually have a capacity of:

    a. 300 PSI
    b. 200 PSI
    c. 500 PSI
    d. 30 PSI

27. What should be used to check the adjustment of the downshift switch of an automatic transmission?

    a. torque wrench
    b. socket wrench
    c. gauge rod and test light
    d. double square socket

28. The engine mounts can affect what on the transmission?

    a. stator
    b. oil pump
    c. fluid coupling
    d. shift linkage

29. A vacuum controlled primary throttle valve can be checked by:

    a. using a front servo gauge
    b. applying a controlled vacuum unit to system
    c. using a rear servo gauge
    d. applying a vacuum gauge to the system

30. What do you use to adjust the band adjusting screw on an automatic transmission?

    a. a preset torque wrench
    b. a hex bit
    c. .250 in gauge block
    d. throttle lever gauge

37.11.03.07

31. If a car with automatic transmission is operating normally but breaks a timing chain and needs to be towed in excess of 100 miles, it can be towed:

    a. safely at moderate speeds
    b. safely at moderate speeds if the fluid level is up
    c. safely if the rear wheels are raised or the drive shaft removed
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32. The function of the vacuum modulator is to:

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    d. allow the car to be push-started when the engine stalls and looses manifold vacuum

33. To replace a defective out put shaft seal in an automatic transmission:

    a. check the counterbore for defects
    b. drain the fluid
    c. disconnect the power train
    d. remove the propeller shaft U-joint yoke.

34. When there is a consistant loss of automatic transmission fluid but no evidence of external leaks it may be necessary to replace the:

    a. vacuum modulator valve
    b. drive shaft torque tube
    c. power servo assembly
    d. internal filter

35. When adjusting the control linkage of an automatic transmission it is not necessary to:

    a. check the anti-stall dashpot
    b. set the engine idle speed
    c. refer to any manuals
    d. remove the selector lever from the steering column

UNIT POST TEST ANSWER KEY: AUTOMATIC TRANSMISSION (B)

Lap 11.03.01

1. C
2. A
3. B
4. D
5. A

Lap 11.03.02

6. C
7. A
8. A
9. C
10. D

Lap 11.03.03

11. B
12. C
13. A
14. B
15. A

Lap 11.03.04

16. D
17. C
18. A
19. C
20. A

Lap 11.03.05

21. A
22. A
23. C
24. B
25. C

Lap 11.03.06

26. A
27. C
28. D
29. B
30. A

Lap 11.03.07

31. C
32. A
33. D
34. A
35. D

Student: ____________________ File Code: 37.11.03.00.C1-2 (C)

Date: ____________________ Date Published: 11/21/77

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UNIT POST TEST: AUTOMATIC TRANSMISSIONS (C)

37.11.02.01

1. The converter vanes are shaped in what way?

   a. square
   b. curved
   c. corrugated
   d. straight

2. *What is the principal difference between a fluid coupling and a torque converter?

   a. the fluid coupling transmits all engine torque but can't multiply it
   b. the fluid coupling can't transmit engine torque but can multiply it
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   a. curved
   b. boxed
   c. straight
   d. corrugated

37.11.03.02

6. For large torque increase what do the planetary pinions rotate around?

   a. the torque converter
   b. the stator
   c. the sun gear
   d. the internal gear

*(From Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1969, p. 250 #10.)

37.11.03.02 cont.

7. In Diagram A,* what is #2?

   a. internal gear
   b. sun gear
   c. planet carrier
   d. torque converter

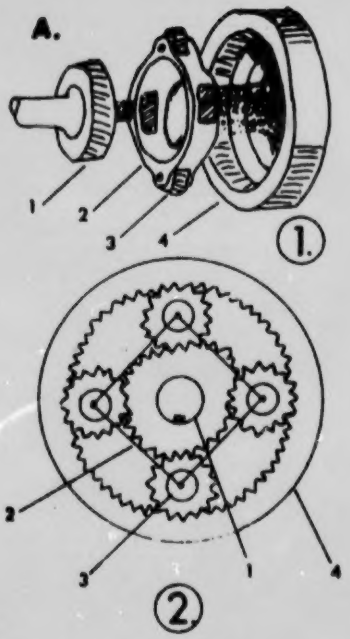
8. In diagram A., what is #3?

   a. planet pinions
   b. fluid coupling
   c. planet carrier
   d. internal gear

9. In diagram A., what is #4?

   a. internal gear
   b. planet pinions
   c. planet carrier
   d. sun gear

A.



*(Adapted from Auto Mechanics Fundamentals, Stockel, Goodheart-Willcox, 1969, p. 213, Fig. 12-27.)

10. For small torque increase, the planetary pinions rotate around the:

    a. stator
    b. fluid coupling
    c. sun gear
    d. internal gear

37.11.03.03

11. What releases the discs in a clutch when the oil pressure drops?

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    c. internal-external type
    d. universal joint

37.11.03.03 cont.

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37.11.03.04

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   a. sea level
   b. low engine vacuum
   c. low engine heat
   d. high elevation

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37.11.03.05

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   a. change the fluid.
   b. check the fluid level
   c. disconnect the drive shaft
   d. disconnect the shift linkage

37.11.03.06

26. What do you use to adjust the band adjusting screw on an automatic transmission?

   a. a preset torque wrench
   b. a hex bit
   c. .250 in gauge block
   d. throttle lever gauge

37.11.03.06 (continued)

27. The engine mounts can affect what on the transmission?

    a. stator
    b. oil pump
    c. fluid coupling
    d. shift linkage

28. What should be used to check the adjustment of the downshift switch of an automatic transmission?

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37.11.03.07

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    d. remove the propeller shaft U-joint yoke.

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    b. set the engine idle speed
    c. refer to any manuals
    d. remove the selectror lever from the steering column

37.11.03.07 (continued)

33. If a car with automatic transmission is operating normally but breaks a timing chain and needs to be towed in excess of 100 miles, it can be towed:

    a. safely at moderate speeds
    b. safely at moderate speeds if the fluid level is up
    c. safely if the rear wheels are raised or the drive shaft removed
    d. if the rear wheels are raised and the drive shaft removed

34. When there is a consistant loss of automatic transmission fluid but no evidence of external leaks it may be necessary to replace the:

    a. vacuum modulator valve
    b. drive shaft torque tube
    c. power servo assembly
    d. internal filter

35. The function of the vacuum modulator is to:

    a. vary the shift points according to load requirements
    b. force a down-shift for passing
    c. sense changes in altitude
    d. allow the car to be push-started when the engine stalls and looses manifold vacuum.

UNIT POST TEST ANSWER KEY: AUTOMATIC TRANSMISSIONS (C)

LAP 11.03.01

1. B
2. A
3. D
4. A
5. C

LAP 11.03.02

6. D
7. C
8. A
9. A
10. C

LAP 11.03.03

11. A
12. B
13. C
14. A
15. B

LAP 11.03.04

16. A
17. C
18. C
19. D
20. A

LAP 11.03.05

21. C
22. A
23. A
24. C
25. B

LAP 11.03.06

26. A
27. D
28. C
29. A
30. B

LAP 11.03.07

31. D
32. D
33. C
34. A
35. A

File Code: 37.11.04.00.B1-1

Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Experience Guide

UNIT: DRIVE SHAFTS

RATIONALE:

The fundamentals and procedures in this unit will enable you to diagnose and replace universal joints and drive shafts.

PREREQUISITES:

None.

OBJECTIVES:

Recognize the components and proper operation of drive shafts.

Use the proper procedures to diagnose and replace universal joints and drive shafts.

RESOURCES:

Printed Materials

Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
National Service Data. Mitchell Manuals. National Automotive Service Inc.

Equipment

Automobile needing: drive shaft repair
universal joint
Automobile with: two piece propeller shaft with center support
Creeper
Jacks or lift
Jack stands
Shims
Tools, basic hand: Chisel and Punch Set
5/32" Pin Punch
3/16" Solid
Gauge, feeler (.002" - .025")
Hammer, ball peen
Hammer, plastic tip
Handle, speed

Principal Author(s): C. Schramm/W. Osland

RESOURCES (Cont.)

Hex Key Set
Pliers, diagonal cutting
Pliers, needle nose
Scraper, gasket
Screwdriver, standard (set)
Screwdriver, Phillips (set)
Screw starter
Socket Set (3/8" drive)
  extension (3")
  ratchet
Socket Set (1/4" drive)
  extension (3")
  handle (6" flex)
  ratchet
Socket, spark plug
  extension (6")
Wrench, combination (set)
Wrench, combination ignition (set)

Universal joint

GENERAL INSTRUCTIONS:

This unit consists of four Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

(1) Read the first assigned Learning Activity Package (LAP).
(2) Begin and complete the first assigned LAP.
(3) Take and score the LAP test.
(4) Turn in the LAP test answer sheet.
(5) Determine the reason for any missed items on the LAP test.
(6) Proceed to and complete the next assigned LAP in the unit.
(7) Complete all required LAPs for the unit by following steps 3 through 6.
(8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
(9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
(10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

.01 Fundamentals of Drive Shafts
.02 Universal Joint Diagnosis
.03 Removing and Replacing Universal Joints
.04 Removing and Replacing Center Supports

EVALUATION PROCEDURE:

When pretesting:

1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

80% correct on unit post test and 80% accuracy on unit performance test.

FOLLOW-THROUGH:

Go to the first Learning Activity Package (LAP) listed on your SPR.

Student: ____________________ File Code: 37.11.04.00.B1-2

Date: ____________________ Date Published: 3/15/76

Mountain-Plains Education &
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UNIT PRETEST: DRIVE SHAFT

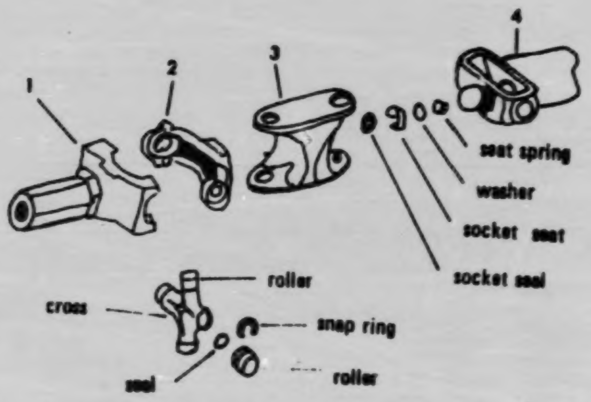
37.11.04.01.

1. When lubricating a ball and trunnion joint, place the lubricator inside:

   a. the dust boot.
   b. no lubrication is needed.
   c. the body raceway.
   d. locating tang.

2. In the diagram*, what is #3?

   a. Centering socket yoke.
   b. Center yoke or link yoke.
   c. Slip yoke.
   d. Socket support yoke.


1
2
3
4
seat spring
washer
socket seat
socket seal
roller
cross
snap ring
seal
roller

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Willcox, 1974, pp. 258 and 259, #s 2 and 4.)

3. To prevent damage to the U-joint, high pressure grease guns require the use of a:

   a. modulator valve.
   b. governor valve.
   c. servo valve.
   d. pressure relief valve.

4. Wing type rollers are secured with:

   a. U-bolts or clamps.
   b. cap screws.
   c. snap ring.
   d. center punching.

5.

37.11.04.02.

6. Angularity of the drive shaft can be checked by the use of a:

   a. feeler gauge.
   b. micrometer.
   c. protractor.
   d. oscilloscope.

7. To maintain correct alignment of the gears, the bearings in a differential are made of:

   a. hardened antifriction bearings.
   b. bronze covered bearings.
   c. spring steel.
   d. aluminum coated bearings.

8. To check the runout on a shaft, you use a:

   a. micrometer.
   b. lube gauge.
   c. dial indicator.
   d. hydrometer.

9. To check clearances on the propeller shaft, you use a:

   a. oscilloscope.
   b. dial indicator.
   c. micrometer.
   d. feeler gauge.

10. To prevent vibration, when drive shafts are made they should be:

    a. lubricated.
    b. balanced.
    c. undercoated.
    d. painted.

37.11.04.03.

11. The front shaft slip yoke engages the:

    a. rear end.
    b. output shaft.
    c. input shaft.
    d. differential pinion gear.

12. The tool used specifically to replace new seal retainers is a:

    a. needle nose pliers.
    b. socket.
    c. hollow punch.
    d. rubber hammer.

13.

14. You can remove a roller with a vise and a:

    a. socket.
    b. rachet.
    c. pair of pliers.
    d. punch.

37.11.04.04.

15. If the center yoke is higher than the front and rear shafts, you can correct by using:

    a. different rollers.
    b. shims.
    c. a different bearing support bracket assembly.
    d. different differential.

UNIT TEST ANSWER SHEET

Occupational Area: ______
File Code: 37.11.04.00.B1-2
Name: ______

ANSWERS

7.11.04.01 1. C ______
2. B ______
3. D ______
4. A ______
5. C ______
7.11.04.02 6. C ______
7. A ______
8. C ______
9. D ______
10. B ______
37.11.04.03 11. B ______
12. C ______
13. A ______
14. A ______
37.11.04.04 15. B ______
16. ______
17. ______
18. ______
19. ______
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58. ______
59. ______
60. ______

File Code: 37.11.04.01.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: Fundamentals of Drive Shafts

OBJECTIVE:

Correctly identify and describe drive lines and components.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions in this LAP.

80% correct on the LAP test.

RESOURCES:

Auto Mechanics Fundamentals. Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 13, pages 261 to 268.
3. On separate paper, answer all of the questions on page 268.
4. Give your answer sheet to the instructor for evaluation.
5. Return the text.
6. Take the LAP test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.04.01.B1-2

Date: ______________________ Date Published: 7-15-76

Revised: 8-14-78

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

LAP TEST: FUNDAMENTALS OF DRIVE SHAFTS

1. When the drive thrust is through the springs, what type of drive may be used?

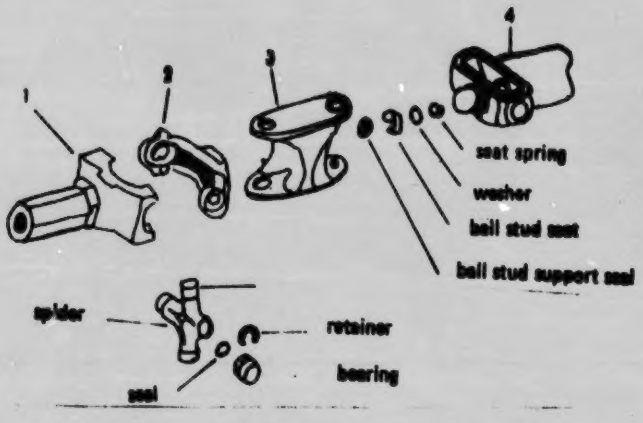
   a. torque tube.
   b. understeer.
   c. vortex.
   d. hotchkiss.

2. In the diagram*, what is #2?

   a. slip yoke.
   b. center yoke.
   c. ball stud support yoke.
   d. centering ball stud yoke.

3. In the diagram*, what is #3?

   a. centering ball stud yoke.
   b. spider.
   c. link yoke.
   d. slip yoke.



*(Adapted from Auto Mechanic Fundamentals, 2nd Edition, Stockel, Goodheart-Wilcox, 1974, page 268, figure 13.23.)

4. The constant velocity universal joint:

   a. is necessary on engines that operate at fixed rpm.
   b. produces very smooth power flow even at large driving angles.
   c. eliminates the need for a slip joint.
   d. is based on a double ball and trunnion joint.

5. The ball and trunnion joint eliminates the need for:

   a. a bearing.
   b. a link yoke.
   c. a slip joint.
   d. a spider.

6. One type of a universal joint is the:

   a. ball and trunnion.
   b. tap and die.
   c. ball and socket.
   d. thrust bearing and tie rod.

7. As the rear axle housing moves up and down in relation to the transmission, what unit allows the necessary flexing of the drive line?

   a. transmission.
   b. propeller shaft.
   c. ball bearings.
   d. yoke.

8. To prevent damage to the U-joint, high pressure grease guns require the use of a:

   a. governor valve.
   b. servo valve.
   c. pressure relief valve.
   d. modulator valve.

9. In the diagram, on page one of this LAP TEST, what is #4?

   a. slip yoke.
   b. drive shaft tube.
   c. center yoke.
   d. centering socket yoke.

10. One type of a universal joint is the:

    a. cross and rollers.
    b. splined joint.
    c. swing axle.
    d. ball and socket.

LAP TEST ANSWER KEY: FUNDAMENTALS OF DRIVE SHAFTS

1. D
2. D
3. C
4. B
5. C
6. A
7. D
8. C
9. B
10. A

File Code: 37.11.04.02.B1-0

Date Published: 3/10/76

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: Universal Joint Diagnosis

OBJECTIVE:

Recognize the proper procedure to diagnose propeller shaft and universal joint problems.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions in this LAP.

Correctly answer at least 8 out of 10 items on a multiple-choice test that is combined with "Removing and Replacing Center Supports" LAP test and is taken after completing that LAP.

RESOURCES:

Auto Service and Repair. Stockel.

PROCEDURE:

1. Obtain a copy of Auto Service and Repair and a quiet place to study.
2. Study Chapter 27, page 27-1 to 27-15.
   NOTE: Study carefully the chart on page 27-14.
3. On separate paper, answer all of the questions on page 27-15.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.04.03.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Removing and Replacing Universal Joints

OBJECTIVE:

Recognize and follow the proper procedure to remove and replace a universal joint.

EVALUATION PROCEDURE:

Correctly answer at least 8 out of 10 items on a multiple-choice test that is combined with "Removing and Replacing Center Supports" LAP test and is taken after completing that LAP.

RESOURCES:

National Service Data.

Automobile needing new U-joint
New U-joint
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Obtain the repair manual for the year and model you are working on.
   NOTE: In some manuals the removal procedure is listed but not the installation procedure. In this case, reverse the removal procedure for installation.
2. Follow the procedure in the manual, and remove and replace the U-joint.
3. Ask the instructor to evaluate your work.
4. Return the manual and tools.
5. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

File Code: 37.11.04.04.B1-0

Date Published: 3/10/76

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Glasgow AFB, Montana 59231

Learning Activity Package

Student: ______________

Date: ______________

PERFORMANCE ACTIVITY: Removing and Replacing Center Supports

OBJECTIVE:

Recognize and follow the proper procedure to remove and replace the center support.

EVALUATION PROCEDURE:

80% correct on LAP test.

RESOURCES:

National Service Data.

Automobile with two-piece propeller shaft.
Shims if needed
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Obtain the repair manual for the year and model you are working on.
2. Follow the procedure in the manual and remove and replace the center support.
   NOTE: On cars equipped with a two-piece drive shaft, the center support must be removed to permit shaft removal.
   If there are any shims between the support and the frame, be sure to replace them during installation.
3. Ask the instructor to evaluate your work.
4. Return the manual and tools.
5. Take the LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.04.02-.04.B1-2

Date: ______________________ Date Published: 3/10/76

Mountain-Plains Education &
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LAP TEST: DIAGNOSIS/REMOVING AND REPLACING UNIVERSAL JOINTS/CENTER SUPPORTS

37.11.04.02.

1. To correct wrong angularity of a shaft, you would:

    a. realign the differential drive pinion.
    b. tighten transmission down tighter.
    c. use shims.
    d. tighten universal and yoke.

2. You will receive bad vibrations in your shaft, if you:

    a. have a bad steering sector.
    b. have your differential carrier on backward.
    c. have your front end out of balance.
    d. undercoat shaft when you undercoat your car.

3. Angularity of the drive shaft can be checked by the use of a(n):

    a. oscilloscope.
    b. protractor.
    c. feeler gauge.
    d. micrometer.

4. To maintain correct alignment of the gears, the bearings in a differential are made of:

    a. spring steel.
    b. hardened antifriction bearings.
    c. aluminum-coated bearings.
    d. bronze-covered bearings.

37.11.04.03.

5. If you have a two-piece shaft on a car, in order to remove the shaft you must:

    a. remove the center bearing.
    b. remove the snap rings on the yokes and remove the rollers.
    c. loosen the transmisison.
    d. loosen the rear end.

6. Before removing the propeller shaft you should:

   a. mark all connecting parts.
   b. lubricate it.
   c. wash it off.
   d. loosen the transmission bolts.

7. When the propeller shaft is removed, you should do what with the rollers?

   a. lubricate them
   b. replace whenever the propeller shaft is removed
   c. tape them on shaft
   d. wash them and place on clean rag

8. Yokes at both ends of the propeller must be in the same:

   a. slip yoke.
   b. output shaft.
   c. plane.
   d. flange yoke.

9. You can remove a roller with a vise and a:

   a. ratchet.
   b. socket.
   c. punch.
   d. pair of pliers.

37.11.04.04.

10. If the center yoke is higher than the front and rear shafts, you can correct by using:

   a. different rollers.
   b. different differential.
   c. a different bearing support bracket assembly.
   d. shims.

37.11.04.02.B1-2
37.11.04.03.B1-2
37.11.04.04.B1-2

LAP TEST ANSWER KEY: DIAGNOSIS/REMOVING AND REPLACING UNIVERSAL JOINTS/CENTER SUPPORTS

LAP 02

1. c
2. d
3. b
4. b

LAP 03

5. a
6. a
7. c
8. c
9. c

LAP 04

10. d

Student: ______________________________ File Code: 37.11.04.00.C1-2 (A)

Date: ______________________________ Date Published: 1/19/78

Mountain-Plains Education &
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UNIT POST TEST: DRIVE SHAFTS

37.11.04.01.

1. What portion of the propeller shaft is easily damaged by clamping in a vise?

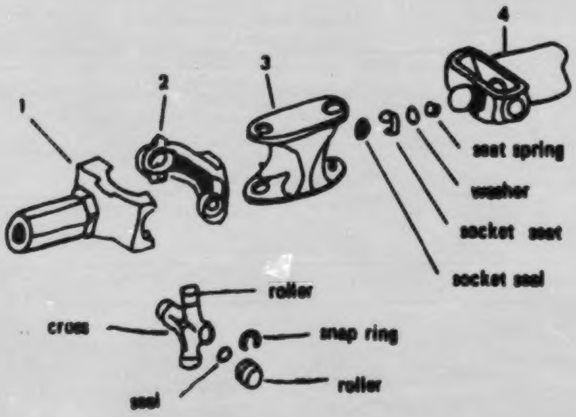
   a. the slip yoke
   b. differential carrier
   c. pinion shaft
   d. the propeller shaft tube

2. As the rear axle housing moves up and down in relation to the transmission, what unit allows the necessary change in length of the drive line?

   a. propeller shaft
   b. ball bearings
   c. transmission
   d. yoke

3. In the diagram*, what is #1?

   a. slip yoke
   b. center yoke
   c. socket support yoke
   d. centering socket yoke


1
2
3
4
seat spring
washer
socket seat
socket seal
roller
cross
snap ring
roller
seal

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Willcox, 1969, pp. 258 and 259, #s 2 and 4.)

37.11.04.01. (Continued)

4. One type of a universal joint is the:

   a. thrust bearing and tie rod
   b. ball and socket
   c. ball and trunnion
   d. tap and die

5. When the drive thrust is through the springs, what type of drive may be used?

   a. understeer
   b. niscasimeter
   c. vortex
   d. hotchkiss

37.11.04.02.

6. When an inspection shows that the bearings in a universal joint are worn, always install:

   a. new bearings
   b. new bearings and a cross
   c. a new cross
   d. new dust seals

7. Bad vibrations will occur in the drive shaft if you:

   a. have your front end out of balance
   b. undercoat shaft when you undercoat your car
   c. have your differential carrier on backward
   d. have a bad steering sector

8. Angularity of the drive shaft can be checked by the use of a:

   a. feeler gauge
   b. micrometer
   c. protractor
   d. oscilloscope

9. To correct wrong angularity of a shaft, you would:

   a. tighten universal and yoke
   b. tighten transmission down tighter
   c. use shims
   d. realign the differential drive pinion

10. When the splined yoke is removed from the transmission:

    a. a puller is required
    b. engine oil leaks out
    c. the extension housing seal must be replaced
    d. transmission oil may leak out

37.11.04.03.

11. A constant velocity joint:

    a. is necessary on two piece drive shafts
    b. is not used on a hotchkiss drive
    c. provides a smoother flow of power
    d. cannot be used with a torque tube

12. Before removing the propeller shaft, you should:

    a. mark all connecting parts
    b. wash it off
    c. lubricate it
    d. loosen the transmission bolts

13. When the propeller shaft is removed, you should do what with the rollers?

    a. replace whenever the propeller shaft is removed
    b. lubricate them
    c. wash them and place on clean rag
    d. tape them on shaft

14. If you have a two-piece shaft on a car, in order to remove the shaft you must:

    a. remove the center bearing
    b. loosen the transmission
    c. loosen the rear end
    d. remove the snap rings on the yokes and remove the rollers

37.11.04.04.

15. The cross and seal retainers are serviced:

    a. as an assembly
    b. individually
    c. once every 50,000 miles if needed or not
    d. only when you replace the drive shaft

UNIT POST TEST ANSWER KEY: DRIVE SHAFTS (A)

1. D
2. D
3. A
4. C
5. D
6. B
7. B
8. C
9. C
10. D
11. C
12. A
13. D
14. A
15. A

Student: ______________________ File Code: 37.11.04.00.C1-2 (B)

Date: ______________________ Date Published: 1/19/78

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UNIT POST TEST: DRIVE SHAFTS (B)

37.11.04.01

1. When the drive thrust is through the springs, what type of drive may be used?

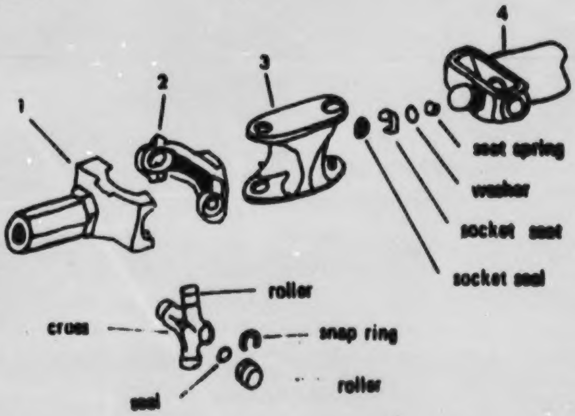
    a. understeer
    b. niscasimeter
    c. vortex
    d. hotchkiss

2. One type of a universal joint is the:

    a. thrust bearing and tie rod
    b. ball and socket
    c. ball and trunnion
    d. tap and die

3. In the diagram,* what is #1?

    a. slip yoke
    b. center yoke
    c. socket support yoke
    d. centering socket yoke



*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Willcox, 1969, pp. 258 and 259, #s 2 and 4.)

4. As the rear axle housing moves up and down in relation to the transmission, what unit allows the necessary flexing of the drive line?

    a. propeller shaft
    b. ball bearings
    c. transmission
    d. yoke

5. What portion of the propeller shaft is easily damaged by clamping in a vise?

    a. the slip yoke
    b. differential carrier
    c. pinion shaft
    d. the propeller shaft tube

37.11.04.02

6. When the splined yoke is removed from the transmission:

   a. a puller is required
   b. engine oil leaks out
   c. the extension housing seal must be replaced
   d. transmission oil may leak out

7. To correct wrong angularity of a shaft, you would:

   a. tighten universal and yoke
   b. tighten transmission down tighter
   c. use shims
   d. realign the differential drive pinion

8. Angularity of the drive shaft can be checked by the use of a:

   a. feeler gauge
   b. micrometer
   c. protractor
   d. oscilloscope

9. Bad vibrations will occur in the drive shaft if you:

   a. have your front end out of balance
   b. undercoat shaft when you undercoat your car
   c. have your differential carrier on backward
   d. have a bad steering sector

10. When an inspection shows that the bearings in a universal joint are worn, always install:

   a. new bearings
   b. new bearings and a cross
   c. a new cross
   d. new dust seals

37.11.04.03

11. If you have a two-piece shaft on a car, in order to remove the shaft you must:

   a. remove the center bearing
   b. loosen the transmission
   c. loosen the rear end
   d. remove the snap rings on the yokes and remove the rollers

12. When the propeller shaft is removed, you should do what with the rollers?

   a. replace whenever the propeller is removed
   b. lubricate them
   c. wash them and place on clean rag
   d. tape them on shaft

37.11.04.03 (continued)

13. Before removing the propeller shaft, you should:

  a. mark all connecting parts
  b. wash it off
  c. lubricate it
  d. loosen the transmission bolts

14. A constant velocity joint:

  a. is necessary on two piece drive shafts
  b. is not used on a hotchkiss drive
  c. provides a smoother flow of power
  d. cannot be used with a torque tube

37.11.04.04

15. The cross and seal retainers are serviced:

  a. as an asssembly
  b. individually
  c. once every 50,000 miles if needed or not
  d. only when you replace the drive shaft

UNIT POST TEST ANSWER KEY: DRIVE SHAFTS (B)

1. D
2. C
3. A
4. D
5. D
6. D
7. C
8. C
9. B
10. B
11. A
12. D
13. A
14. C
15. A

Student: ______________________ File Code: 37.11.04.00.C1-2 (C)

Date: ______________________ Date Published 1/19/78

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UNIT POST TEST: DRIVE SHAFTS (C)

37.11.04.01

1. What portion of the propeller shaft is easily damaged by clamping in a vise?

   a. the slip yoke
   b. differential carrier
   c. pinion shaft
   d. the propeller shaft tube

2. One type of a universal joint is the:

   a. thrust bearing and tie rod
   b. ball and socket
   c. ball and trunnion
   d. tap and die

3. As the rear axle housing moves up and down in relation to the transmission, what unit allows the necessary flexing of the drive line?

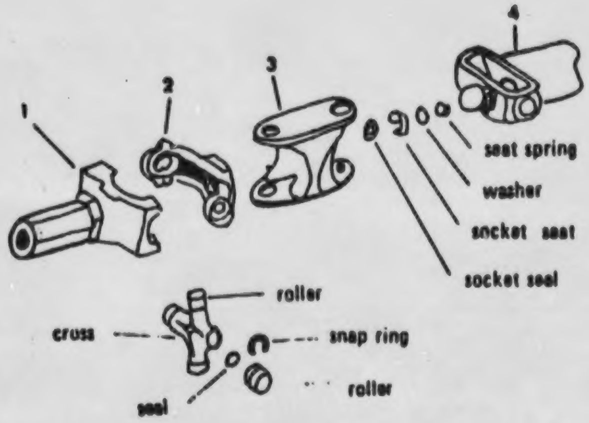
   a. propeller shaft
   b. ball bearings
   c. transmission
   d. yoke

4. When the drive thrust is through the springs, what type of drive may be used?

   a. understeer
   b. niscasimeter
   c. vortex
   d. hotchkiss

5. In the diagram,* what is #1?

   a. slip yoke
   b. center yoke
   c. socket support yoke
   d. centering socket yoke



*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Willcox, 1969, pp. 258

37.11.04.02

6. Angularity of the drive can be checked by the use of a:

   a. feeler gauge
   b. micrometer
   c. protractor
   d. oscilloscope

7. When an inspection shows that the bearings in a universal joint are worn, always install:

   a. new bearings
   b. new bearings and a cross
   c. a new cross
   d. new dust seals

8. To correct wrong angularity of a shaft, you would:

   a. tighten universal and yoke
   b. tighten transmission down tighter
   c. use shims
   d. realign the differential drive pinion

9. Bad vibrations will occur in the drive shaft if you:

   a. have your front end out of balance
   b. undercoat shaft when you undercoat your car
   c. have your differential carrier on backward
   d. have a bad steering sector

10. When the splined yoke is removed from the transmission:

   a. a puller is required
   b. engine oil leaks out
   c. the extension housing seal must be replaced
   d. transmission oil may leak out

37.11.04.03

11. If you have a two-piece shaft on a car, in order to remove the shaft you must:

   a. remove the center bearing
   b. loosen the transmission
   c. loosen the rear end
   d. remove the snap rings on the yokes and remove the rollers

12. Before removing the propeller shaft, you should:

   a. mark all connecting parts
   b. wash it off
   c. lubricate it
   d. loosen the transmission bolts

37.11.04.03 (continued)

13. When the propeller shaft is removed, you should do what with the rollers?

    a. replace whenever the propeller shaft is removed
    b. lubricate them
    c. wash them and place on clean rag
    d. tape them on shaft

14. A constant velocity joint:

    a. is necessary on two piece drive shafts
    b. is not used on a hotchkiss drive
    c. provides a smoother flow of power
    d. cannot be used with a torque tube

37.11.04.04

15. The cross and seal retainers are serviced:

    a. as an assembly
    b. individually
    c. once every 50,000 miles if needed or not
    d. only when you replace the drive shaft

UNIT POST TEST ANSWER KEY: DRIVE SHAFTS (C)

1. D
2. C
3. D
4. D
5. A
6. C
7. B
8. C
9. B
10. D
11. A
12. A
13. D
14. C
15. A

Student: ______________________ File Code: 37.11.04.00.B1-5

Date: ______________________ Date Published: 3/10/76

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Family Pay Number: __________ Sex: M F (Circle 1)

UNIT PERFORMANCE TEST: DRIVE SHAFTS

OBJECTIVE:

Remove and repair drive shafts.

TASK:

The student will be assigned a vehicle on which he must remove and replace universal joints and center supports.

ASSIGNMENT:

CONDITIONS:

The student may use only those materials provided for the test and perform the test in the auto shop.

RESOURCES:

Jacks
Jack stands
Creeper
Auto needing drive shaft repair
Service manual
Time and parts manual
New center support
New universal joints

RESOURCES: (Continued)

Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

Student: ____________________ **File Code:** 37.11.04.00.B1-5

Date: ____________________ **Date Published:** 3/10/76

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Family Pay Number: ________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective:		
1. Remove and replace universal joints.		
2. Remove and replace center supports.		
Criterion: Must meet manufacturer's specifications.		
3. Complete test in allotted time.		
Criterion: Meet flat rate on assigned vehicle.		
Student must satisfactorily complete 2 of 3 line items to pass test.		

File Code: 37.11.05.00.B1-1

Date Published: 3/10/76

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Learning Experience Guide

UNIT: DIFFERENTIALS

RATIONALE:

The fundamentals and procedures in this unit will enable you to diagnose and repair differentials.

PREREQUISITES:

None.

OBJECTIVES:

Recognize the components and the proper operation of differentials.

Use the proper procedures to diagnosis and repair of differentials.

RESOURCES:

Printed Materials

Auto Mechanics Fundamentals. Martin W. Stockel, Goodheart-Willcox Company, Inc.
Auto Service and Repair. Martin W. Stockel, Goodheart-Willcox Company, Inc.
National Service Data. Mitchell Manuals. National Automotive Service Inc.

Equipment

Automobile needing: axle bearing and seal replacement
differential repair
Automobile with: rear axle assembly
Axle housing
Bearings
Carrier and pinion bearing
C-clamp
Cleaning solvent
Dial indicator
Differential unit
Drain pan
Feeler gauges
Jacks or lift
Jack stands
Press
Press, hydraulic

Principal Author(s): C. Schramm/W. Osland

RESOURCES (Cont.)

Seals
Seal remover
Tools, basic hand:
- Chisel and Punch Set
  - 5/32" Pin Punch
  - 3/16" Solid
- Gauge, feeler (.002" - .025")
- Hammer, ball peen
- Hammer, plastic tip
- Handle, speed
- Hex Key Set
- Pliers, diagonal cutting
- Pliers, needle nose
- Scraper, gasket
- Screwdriver, standard (set)
- Screwdriver, Phillips (set)
- Screw starter
- Socket Set (3/8" drive)
  - extension (3")
  - ratchet
- Socket Set (1/4" drive)
  - extension (3")
  - handle (6" flex)
  - ratchet
- Socket, spark plug
  - extension (6")
- Wrench, combination (set)
- Wrench, combination ignition (set)

Torque wrench
Trouble light
White lead
Vise

GENERAL INSTRUCTIONS:

This unit consists of eight Learning Activity Packages (LAPs). Each LAP will provide specific information for completion of a learning activity.

The general procedure for this unit is as follows:

(1) Read the first assigned Learning Activity Package (LAP).
(2) Begin and complete the first assigned LAP.
(3) Take and score the LAP test.
(4) Turn in the LAP test answer sheet.
(5) Determine the reason for any missed items on the LAP test.
(6) Proceed to and complete the next assigned LAP in the unit.
(7) Complete all required LAPs for the unit by following steps 3 through 6.
(8) In this Unit, there are some LAPs that have tests combined with other LAP tests. These combined tests are taken after completing the last LAP covered by the test.
(9) Take the unit tests as described in the Unit LEG "Evaluation Procedures".
(10) Proceed to the next assigned unit.

PERFORMANCE ACTIVITIES:

.01 Fundamentals of Differentials
.02 Limited Slip Differentials
.03 Remove and Replace Axle
.04 Replacing Axle Bearing and Seal
.05 Remove and Replace Differential
.06 Ring and Pinion Gears
.07 Carrier and Pinion Bearings
.08 Adjusting Backlash

EVALUATION PROCEDURE:

When pretesting:

1. The student takes the unit multiple-choice pretest.
2. Successful completion is 4 out of 5 items for each LAP part of the pretest.
3. The student then takes a unit performance test if the unit pretest was successfully completed.
4. Satisfactory completion of the performance test is meeting the criteria listed on the performance test.

When post testing:

1. The student takes a multiple-choice unit post test and a unit performance test.
2. Successful unit completion is meeting the listed criteria for the performance test.

FOLLOW-THROUGH:

Go to the first assigned Learning Activity Package (LAP) listed on your Student Progress Record (SPR).

Student: ______________________ **File Code:** 37.11.05.00.B1-2

Date: ______________________ **Date Published:** 3/15/76

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UNIT PRETEST: DIFFERENTIALS

37.11.05.01.

1. The axle assembly is lubricated by:

   a. light oil.
   b. the transmission.
   c. sae 90 weight lubrication.
   d. propeller shaft.

2. Name one unit of a rear axle assembly.

   a. axle.
   b. leaf springs.
   c. U-shackles.
   d. propeller shaft.

3. The outer ends of the axles run in:

   a. brash bushings.
   b. bronze bushings.
   c. rubber seals.
   d. roller or ball bearings.

4. Name a type of axle.

   a. torsional.
   b. one-quarter floating.
   c. thrust type.
   d. three-quarter floating.

5. What turns the differential ring gear pinion and shaft?

   a. the axles.
   b. the transmission.
   c. the tires.
   d. the propeller shaft.

37.11.05.02.

6. A Chrysler sure-grip differential's axles side gears are driven by how many pinions?

   a. 4.
   b. 3.
   c. 2.
   d. 1.

37.11.05.02. cont.

7. What is used in the back of each axles side gear on Chrysler sure-grip?

   a. cove gears.
   b. six clutch disc.
   c. four clutch disc.
   d. pinions.

8. How many clutch discs are splined to the differential case? (Chrysler sure-grip)

   a. 6.
   b. 4.
   c. 2.
   d. 3.

9. The thrust member is splined to the: (Chrysler sure-grip)

   a. pinion shaft.
   b. axle.
   c. side gears.
   d. differential case.

10. On a sure-grip differential what is forced to rotate with the differential case?

   a. rear end.
   b. transmission.
   c. pinion shafts.
   d. drive sprocket.

37.11.05.03.

11. After taking an axle apart, you should:

   a. heat it for easier dismantling.
   b. lubricate it.
   c. wash it.
   d. cool it.

12. Before removing the axle, you should measure:

   a. the outside of the axle.
   b. the gear ratio.
   c. end play.
   d. the power train assembly angle.

13. Excessive backlash should be corrected by:

   a. tightening the pinion nut.
   b. replacing defective parts.
   c. adjusting the side-gear yoke.
   d. adjusting the pinion shafts adjusting nut.

37.11.05.03. cont.

14. You would check for backlash with a:

a. dial indicator.
b. feeler gauge.
c. micrometer.
d. hydrometer.

15. When casing is completely stripped down and just before reassembly, you should:

a. fill housing with lubrication.
b. replace all oil seals.
c. flush housing thoroughly.
d. put lineshaft back on the precise way you removed it.

37.11.05.04.

16. To remove the axles, you would use a:

a. press jack.
b. slide hammer type puller.
c. spreader.
d. pry bar.

17. To remove the bearing retainer, you use:

a. a puller.
b. a punch.
c. a chisel.
d. a pliers.

18.

19. When you remove a bearing, you do so by:

a. applying heat to case so you can slip bearing out.
b. rapping it out.
c. prying it out.
d. pressing it off.

20. The small end of a seal protector goes in what direction?

a. pointing toward the housing.
b. pointing toward splined end of axle shaft.
c. it doesn't matter what way it goes in.
d. point toward the pinion gear.

37.11.05.05.

21. After draining the housing, you remove:

    a. the pinion bearing.
    b. one axle shaft.
    c. the axle housing.
    d. both axle shafts.

22. Before removing the differential case side bearing caps, make certain each cap and adjustment nut is:

    a. loosened.
    b. marked.
    c. tightened.
    d. measured.

23.

24. When tightening a pinion flange retaining nut on installations using a collapsible spacer, what must be done if the preload is exceeded?

    a. leave preload above.
    b. back off nut until preload is correct.
    c. back off nut past correct preload and tighten until preload is correct.
    d. install a new spacer.

25. When attaching the ring gear to the case flange, use:

    a. double-headed nuts.
    b. any fasteners of the right size.
    c. fasteners with split back washers.
    d. special fasteners for the purpose.

37.11.05.06.

26. What is a hypoid gear setup as used in the differential?

    a. no-slip rear end.
    b. pinion gear engages ring gear above axle centerline.
    c. cam clutch in synchronism with the side gear.
    d. pinion gear engages ring gear below the center line.

27. What is a spiral bevel gear?

    a. a pinion shaft support.
    b. another type of ring and pinion gear.
    c. a type of side gear.
    d. a gear used on tapered wheel hub.

37.11.05.06. cont.

28. What advantage does the spiral bevel gear have over the spur bevel?

    a. less tooth contact.
    b. the teeth are straight.
    c. it's quieter.
    d. center the tongue load on one tooth.

29. You check ring and pinion tooth contact pattern by:

    a. coating ring gear with red lead and oil mixture.
    b. a feeler gauge.
    c. a dial indicator.
    d. applying grease to the pinion gear and rotating gear in a full circle.

30. To regulate or adjust the pinion depth, you:

    a. use shims.
    b. adjust ring gears.
    c. adjust backlash.
    d. replace the pinion gear.

37.11.05.07.

31. What contains the carrier and pinion bearings?

    a. the differential carrier.
    b. the transmission.
    c. the clutch plates.
    d. the bell housing.

32. To clean bearings you wash them in:

    a. gasoline.
    b. cleaning solvent.
    c. hot soapy water.
    d. diesel fuel.

33. To dry bearings, you:

    a. use a clean rag.
    b. let evaporate.
    c. apply heat.
    d. use compressed air.

34. When replacing pinion gears and replacing a bearing cup, what do you use to remove the bearing cup?

    a. a needle vise pliers.
    b. a screwdriver.
    c. a hollow punch.
    d. a puller.

37.11.05.07. cont.

35. You install a bearing by:

    a. lubricating and slipping into position.
    b. driving it into position.
    c. heating and slipping it into position.
    d. cooling and slipping it into position.

37.11.05.08.

36. Why do you rotate differential cases a few times?

    a. to seat bearings.
    b. to seal pinion gears.
    c. to seal side gear.
    d. to adjust preload.

37. You measure backlash with a:

    a. dial indicator.
    b. micrometer.
    c. feeler gauge.
    d. hydrometer.

38. You check backlash in how many different spots around the gear?

    a. 3.
    b. 4.
    c. 2.
    d. 1.

39. Backlash must not vary more than:

    a. .002.
    b. .005.
    c. 0.101.
    d. .020.

40. For each .001 change in backlash desired, you transfer how many thousands of shims?

    a. .001.
    b. .002.
    c. .005.
    d. .003.

PRETEST

UNIT TEST ANSWER SHEET

Occupational Area: ______________________
File Code: 37.11.05.00.B1-2
Name: ______________________
Family Pay Number ______________________ Sex M F (Circle 1)

ANSWERS

.11.05.01	1.	C	37.11.05.05	21.	D	41.	
	2.	A		22.	B	42.	
	3.	D		23.	D	43.	
	4.	D		24.	D	44.	
	5.	D		25.	D	45.	
.11.05.02	6.	A	37.11.05.06	26.	D	46.	
	7.	C		27.	B	47.	
	8.	C		28.	C	48.	
	9.	B		29.	A	49.	
	10.	C		30.	A	50.	
.11.05.03	11.	C	37.11.05.07	31.	A	51.	
	12.	C		32.	B	52.	
	13.	B		33.	D	53.	
	14.	A		34.	D	54.	
	15.	C		35.	B	55.	
.11.05.04	16.	B	37.11.05.08	36.	A	56.	
	17.	C		37.	A	57.	
	18.	A		38.	B	58.	
	19.	D		39.	A	59.	
	20.	B		40.	B	60.	

File Code: 37.11.05.01.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Fundamentals of Differentials

OBJECTIVE:

Recognize the components and proper operation of differentials.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions in this LAP and 80% on LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 14, pages 269-271, "The Differential".
3. On separate paper, answer questions 1 through 12 on page 281.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Take the LAP test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.05.01.B1-2

Date: ______________________ Date Published: 3-10-76

Revised: 8-14-78

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

LAP TEST: FUNDAMENTALS OF DIFFERENTIALS

1. Which of the following is a type of axle?

   a. three-quarter floating.
   b. torsional.
   c. thrust type.
   d. one-quarter floating.

2. One type of housing that is used to house a differential is:

   a. the strut.
   b. the forked.
   c. the split.
   d. the spline.

3. One type of differential housing is the:

   a. strut.
   b. hanger assembly type.
   c. banjo.
   d. spring leaf.

4. Name one unit of a rear axle assembly.

   a. differential.
   b. U-joints.
   c. swing arm
   d. center joints.

5. How many ways are there to attach a rear hub to the axle?

   a. 3
   b. 2
   c. 1
   d. 4

6. What turns the differential ring gear pinion and shaft?

   a. the axles
   b. the tires
   c. the transmission
   d. the propeller shaft.

7. The axle assembly is lubricated by:

   a. SAE 90 weight lubrication.
   b. the transmission.
   c. propeller shaft.
   d. light oil.

8. How many different types of axles are there?

   a. 4
   b. 5
   c. 2
   d. 3

9. The ring gear is in direct contact with:

   a. a special head gear.
   b. a propeller shaft.
   c. the transmission.
   d. a pinion gear.

10. The most widely used housing for a differential is:

    a. the banjo.
    b. the strut.
    c. the forked.
    d. the split.

LAP TEST ANSWER KEY: FUNDAMENTALS OF DIFFERENTIALS

1. a
2. c
3. c
4. a
5. b
6. d
7. a
8. d
9. d
10. a

File Code: 37.11.05.02.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Limited-Slip Differentials

OBJECTIVE:

Recognize the parts and operation of the limited-slip differential.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions in this LAP and 80% correct on LAP test.

RESOURCES:

Auto Mechanics Fundamentals, Stockel,

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 14, pages 271-277.
3. On separate paper, answer questions 13, 14, and 15 on page 281.
4. Give the answer sheet to the instructor for evaluation.
5. Return the text.
6. Take the LAP test.
7. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.05.02.B1-2

Date: ______________________ Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

LAP TEST: LIMITED SLIP DIFFERENTIALS

1. How many pinion shafts does a Chrysler sure-grip differential have?

   a. 3
   b. 1
   c. 4
   d. 2

2. What is used in the back of each axle side gear?

   a. four-clutch disc
   b. pinions
   c. six-clutch disc
   d. cove gears

3. How many clutch discs are splined to the differential case?

   a. 6
   b. 4
   c. 2
   d. 3

4. The thrust member is splined to the:

   a. side gears.
   b. axle.
   c. differential case.
   d. pinion shaft.

5. On a sure-grip differential what is forced to rotate with the differential case?

   a. drive sprocket
   b. rear end
   c. transmission
   d. pinion shafts

LAP TEST ANSWER KEY: LIMITED-SLIP DIFFERENTIALS

1. d
2. a
3. c
4. b
5. d

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File Code: 37.11.05.03.B1-0

Date Published: 3/10/76

Learning Activity Package

Student:

Date:

PERFORMANCE ACTIVITY: Remove and Replace Axle

OBJECTIVE:

Recognize and follow proper procedure to remove and replace the rear axle.

EVALUATION PROCEDURE:

Correctly answer at least 8 out of 10 items on a multiple-choice test that is combined with "Replacing Axle Bearings and Seals" LAP test and is taken after completing that LAP.

RESOURCES:

National Service Data.

Automobile with rear axle assembly
Slide-hammer puller
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Obtain the repair manual for the year and model you are working on.
2. Follow the procedure outlined in the manual and remove and replace the axle.
   NOTE: If a piece of broken axle is left in the housing, try using a magnet or a tapered spring spiral on a handle to retrieve the piece. Be sure to flush the housing thoroughly to remove any metal chips.
3. Ask the instructor to evaluate your work.
4. Return manual, tools, and equipment.
5. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Mountain-Plains Education & Economic Development Program, Inc.
Glasgow AFB, Montana 59231

File Code: 37.11.05.04.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Replacing Axle Bearings and Seals

OBJECTIVE:

Recognize and follow proper procedure to replace the axle bearing and axle seal.

EVALUATION PROCEDURE:

80% correct on LAP test.

RESOURCES:

National Service Data.

Automobile needing axle bearing and seal replacement
C-clamp
Floor jack and jack stands
Hydraulic press
Goggles
New axle bearing and seal
Seal removal tool
Seal installation tool
Tools, Basic Hand: (See Unit LEG)
Wheel bearing grease
Work order

PROCEDURE:

1. Diagnose wheel bearing noise to locate the exact defective bearing. Record results on a work order.
2. Raise vehicle and secure safety stands.
3. Remove wheel and drum assembly.
4. Remove axle. Refer to repair manual for correct removal procedure.
   NOTE: Some vehicles have interlocks in the differential that hold the axle in place while other vehicles may use only four retaining bolts at the end of the axle housing.
5. Before removing axle bearing or seal, compare the new replacement parts with the old ones to insure exact positive replacement. The removal procedure for the bearing and seal will cause damage, therefore, rendering them unusable.

Principal Author(s): J. Anderson/W. Osland

PROCEDURE: (continued)

6. After confirmation of correct parts, remove the axle bearing with hydraulic press and C-clamp plate. Refer to press operator's manual.
   - A. Position axle in a vise andremove axle bearing retainer ring with a cold chisel and hammer. Use caution to prevent damaging the axle shaft.
   - B. Position the C-clamp around the axle shaft between the bearing and axle hub.
   - C. Position the axle with the C-clamp in the hydraulic press to force the axle down through the bearing and C-clamp.

     CAUTION: 1. Be sure all components are positively secured.
     2. Wear eye protection.
     3. Observe the pressure limitation gauge.
   - D. If the bearing fails to release under normal pressure, ask the instructor for assistance.
7. Notice the position of the old bearing races and axle housing retainer plate on the shaft to insure exact correct repositioning of the new bearing and retainer plate before pressing into place. There is a wrong and a right way for the bearing. The bearing will fit either way, but will operate satisfactorily only when fitted the correct way.
8. Position the C-clamp behind the bearing and press into place.
9. Lubricate bearing with quality, high temperature, wheel bearing grease.
10. Remove the axle seal with a seal removal tool.
11. Install correct seal with a seal installation tool in the correct position. Lubricate the seal lip with grease.
12. Install axle in housing. Tighten bolts to the correct torque.
13. Replace drum and wheel assembly.
14. Lower vehicle to floor.
15. Clean and return all tools and equipment.
16. Clean work area.
17. Take the LAP test.

Student: ____________________ File Code: 37.11.05.03-.04 B1-2

Date: ____________________ Date Published: 12-6-77

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

LAP TEST: REMOVE AND REPLACE AXLE/AXLE BEARING AND SEAL

37.11.05.03

1. To prevent damage to the oil seal when reinstalling, you:
   - a. coat axle shaft with lubricant for 6".
   - b. install a new seal.
   - c. place plug in axle hole.
   - d. apply light heat to soften seal for installation.

2. You would check for backlash with a:
   - a. hydrometer.
   - b. dial indicator.
   - c. micrometer.
   - d. feeler gauge.

3. When casing is completely stripped down and just before reassembly, you should:
   - a. replace all oil seals.
   - b. fill housing with lubrication.
   - c. flush housing thoroughly.
   - d. put lineshaft back on the precise way you removed it.

4. Before removing the axle, you should measure:
   - a. the gear ratio.
   - b. the outside diameter of the axle.
   - c. end play.
   - d. the power train assembly angle.

5. Before removing the drive shaft, you should:
   - a. remove your exhaust pipe.
   - b. remove the transmission.
   - c. measure angle of power train.
   - d. mark universal joints.

37.11.05.04

6. Rear axle wheel bearings are:
   - a. never lubricated by rear axle lubricant.
   - b. generally lubricated for life and isolated from the axle lubricant.
   - c. supposed to be removed and lubricated periodically.
   - d. the type that cannot be lubricated by gear oil.

37.11.05.04

7. To remove the axles, you would use a:

   a. press jack.
   b. pry bar.
   c. slide hammer type puller.
   d. spreader.

8. To remove the bearing retainer, you use:

   a. a punch.
   b. a puller.
   c. a pliers.
   d. a chisel.

9. The small end of a seal protector goes in what direction?

   a. pointing toward the housing.
   b. it doesn't matter what way it goes in.
   c. pointing toward the pinion gear.
   d. pointing toward splined end of axle shaft.

10. When you remove a bearing, you do so by:

   a. applying heat to case so you can slip bearing out.
   b. rapping it out.
   c. prying it out.
   d. pressing it out.

LAP TEST ANSWER KEY: REMOVE AND REPLACE AXLE/AXLE BEARINGS AND SEAL

LAP .03

1. a
2. b
3. c
4. c
5. d

LAP .04

6. b
7. c
8. d
9. d
10. d

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Glasgow AFB, Montana 59231

File Code: 37.11.05.05.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ____________

Date: ____________

PERFORMANCE ACTIVITY: Remove and Replace Differential

OBJECTIVE:

Recognize and follow proper procedure to remove and replace a differential.

EVALUATION PROCEDURE:

80% correct on LAP test.

RESOURCES:

National Service Data.

Axle housing equipped with differential
Tools, Basic Hand: (See Unit LEG)

PROCEDURE:

1. Obtain a copy of the repair manual for the year and model that you are working on.
   NOTE: See the procedure in the manual for axle removal. The axles must be removed first. Be sure to check the drive pinion shaft preload before removal. The differential is heavy, so use caution during removal.
2. Follow the procedure outlined in the manual and remove and replace the differential.
3. Ask the instructor to evaluate your work.
4. Return the manual and tools.
5. Take the LAP test.
6. Proceed to the next LAP.

Principal Author(s): C. Schramm/W. Osland

Student: ____________________ File Code: 37.11.05.05.B1-2

Date: ____________________ Date Published: 3/10/76

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

LAP TEST: REMOVE AND REPLACE DIFFERENTIAL

1. After you have the car jacked up and secured, you remove the:

   a. pinion drive gear.
   b. drive shaft.
   c. pinion shaft.
   d. differential case.

2. Axle wheel bearing retainer rings may be removed from the axle after:

   a. cutting with a torch.
   b. heating.
   c. notching with a chisel.
   d. chilling.

3. When replacing the pinion flange, if it goes on hard:

   a. heat the flange.
   b. heat the pinion shaft.
   c. drive on with a soft hammer.
   d. use a puller.

4. Proper ring and pinion tooth contact pattern is important. The pattern should generally be:

   a. centralized between top and bottom of the tooth but closer to top.
   b. near the top of the tooth and extending over the entire length.
   c. centralized between the top and bottom of the tooth but closer to bottom.
   d. centralized on the tooth.

5. Before removing the differential case side bearing caps, make certain each cap and adjusting nut is:

   a. measured.
   b. tightened.
   c. marked.
   d. loosened.

6. When tightening pinion flange retaining nut on installations using a collapsible spacer, what must be done if the preload is exceeded?

   a. back off nut until preload is correct
   b. leave preload above
   c. back off nut past correct preload and tighten until preload is correct
   d. install new spacers

7. If the differential case is of the shim adjusted preload type, you remove it with:

   a. two pry bars.
   b. an easyout.
   c. a spreader.
   d. both _a_ and _c_.

8. Before removal of the differential case, it is good practice to:

   a. check propeller shaft alignment.
   b. remove the differential case side bearing.
   c. check backlash.
   d. check lubricant level.

9. After draining the housing, you remove:

   a. the pinion bearing.
   b. the axle housing.
   c. one axle shaft.
   d. both axle shafts.

10. When attaching the ring gear to the case flange, use:

   a. special fasteners for the purpose.
   b. double-headed nuts.
   c. fasteners with split back washers.
   d. any fasteners of the right size.

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File Code: 37.11.05.06.B1-0

Date Published: 3/10/76

Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Ring and Pinion Gears

OBJECTIVE:

Recognize the components and operation of ring and pinion gears.

EVALUATION PROCEDURE:

Score at least 80% correct on the study questions in the LAP.
Correctly answer at least 8 out of 10 items on a multiple-choice test.
[illegible] ed with Limited Slip [illegible] LAP test and [illegible] that LAP.

RESOURCES:

Auto Mechanics Fundamentals, Stockel.

PROCEDURE:

1. Obtain a copy of Auto Mechanics Fundamentals and a quiet place to study.
2. Study Chapter 14, pages 277-281.
3. On separate paper, answer questions 16 through 29 on page 281.
4. Give your answer sheet to the instructor for evaluation.
5. Return the text.
6. Proceed to the next LAP.
7. Take the LAP test.

Principal Author(s): C. Schramm/W. Osland

Student: ______________________ File Code: 37.11.05.06.B1-2

Date: ______________________ Date Published: 3/10/76

Mountain-Plains Education &
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LAP TEST: RING AND PINION GEARS

1. To regulate or adjust the pinion depth, you:

   a. adjust ring gears.
   b. replace the pinion gear.
   c. use shims.
   d. adjust backlash.

*2. What is a spiral bevel gear?

   a. A type of side gear.
   b. A gear used on the tapered wheel hub.
   c. Another type of ring and pinion gear.
   d. A pinion shaft support.

3. What is a hypoid gear setup as used in the differential?

   a. No-slip rear end.
   b. Pinion gear engages ring gear below the center line.
   c. Pinion gear engages ring gear above axle center line.
   d. Cam clutch in synchronism with the side gear.

*4. What advantage does the spiral bevel gear have over the spur bevel?

   a. the teeth are straight
   b. less tooth contact
   c. center the tongue load on one tooth
   d. it's quieter

*5. Why is a hypoid used?

   a. To facilitate lowering the body of the car.
   b. To facilitate raising the body of the car.
   c. To insure the rear end won't slip.
   d. To reduce wear on the clutch plates.

* (Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Willcox, 1974, p. 274, #s 16, 17, 18, 19.)

LAP TEST ANSWER KEY: RING AND PINION GEARS

1. c
2. c
3. b
4. d
5. a

File Code: 37.11.05.07.B1-0

Date Published: 3/10/76

Mountain-Plains Education &
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Learning Activity Package

Student: ____________________

Date: ____________________

PERFORMANCE ACTIVITY: Carrier and Pinion Bearings

OBJECTIVE:

Demonstrate inspecting carrier and pinion bearings.

EVALUATION PROCEDURE:

Correctly answering at least 8 out of 10 items on a multiple-choice test that is combined with "Adjusting Backlash" LAP test and is taken after completing that LAP.

RESOURCES:

National Service Data.

Carrier and pinion bearings
Cleaning solvent
Trouble light

PROCEDURE:

1. Clean bearings and bearing races thoroughly and dry completely.
2. Using a trouble light, inspect the bearing and bearing races for spalling, brineling, overheating, cracked rings, broken or dented cage, dented shields, corrosion, and dirt wear.
3. Check bearing for free smooth movement. The bearing should revolve smoothly with no catching (stopping momentarily) or roughness. If either condition is present, rinse and blow dry again. If the conditions still persist, discard the bearings.
4. In replacing the bearings, locate the brand name and number on the bearing for accurate placement.
5. Record all inspection results.
6. Ask the instructor to evaluate your completed inspection.
7. Clean and return all tools and equipment.
8. Clean work area.
9. Proceed to the next LAP.

Principal Author(s): J. Anderson/W. Osland

File Code: 37.11.05.08.B1-0

Date Published: 3/10/76

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Learning Activity Package

Student: ______________________

Date: ______________________

PERFORMANCE ACTIVITY: Adjusting Backlash

OBJECTIVE:

Recognize and follow the correct procedure to adjust backlash.

EVALUATION PROCEDURE:

80% correct on the LAP test.

RESOURCES:

National Service Data.

Differential unit
Dial indicator
Tools, Basic Hand: (See Unit LEG)
White lead

PROCEDURE:

1. Position the differential unit for easy access to the adjustments.
2. Refer to the manual to locate the adjustments and adjustment procedures.
3. Adjustment procedures, specifications, and adjustment points vary from make depending upon the manufacturer.
4. Refer to the manual's specifications to locate the backlash allowance requirement. Record it.
5. Also refer to the manual for the correct teeth contact pattern.
6. Attach the dial indicator to check the amount of backlash before disassembly. Refer to the manual for the procedure to attach the dial indicator correctly.
7. While working the tester gear back and forth, carefully read the dial indicator. Record the reading.
8. Compare the specification allowance with the tested reading.
9. Demonstrate the dial indicator operation to the instructor for evaluation and discuss the results with him.

Principal Author(s): J. Anderson/W. Osland

PROCEDURE: (continued)

10. Check the present tooth contact pattern using white lead. Compare the resulting pattern to the recommended pattern from the manual. Record the results.
11. Explain to the instructor the pattern test and the test results.

    NOTE: In the process of re-using the same ring and pinion gear, it is mandatory to duplicate the original tooth contact pattern to prevent ring and pinion noise. The backlash can be adjusted causing no undesired noises as long as the same tooth contact pattern is maintained.
12. Adjust the backlash following the adjustment procedure shown in the manual to meet the manufacturer's specifications.
13. Test the backlash and indicate to the instructor the correct reading when completed. Also test the tooth contact pattern to insure exact prior position.
14. Clean and return all tools and equipment.
15. Clean work area.
16. Take the LAP test.

Student: ______________________ **File Code:** 37.11.05.07 & .08 B1-2

Date: ______________________ **Date Published:** 11-28-77

Mountain-Plains Education &
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LAP TEST: CARRIER AND PINION BEARING/ADJUSTING BACKLASH

37.11.05.07

1. To dry bearings, you:

   a. apply heat.
   b. let evaporate.
   c. use compressed air.
   d. use a clean rag.

2. To clean bearings, you wash them in:

   a. diesel fuel.
   b. hot soapy water.
   c. cleaning solvent.
   d. gasoline.

3. What contrains the carrier and pinion bearings?

   a. the differential carrier.
   b. the transmission.
   c. the bell housing.
   d. the clutch plates.

4. When making pinoin bearing preload adjustments, care must be taken not to:

   a. overtighten the companion flange nut.
   b. re-use the crush sleeve.
   c. loosen the companion flange nut.
   d. all of the above

5. You install a bearing by:

   a. heating and slipping it into position.
   b. lubricating and slipping into position.
   c. lubricating and driving it into position.
   d. cooling and slipping it into position.

37.11.05.08

6. For each .001 change in backlash desired, you transfer how many thousands of shims?

   a. .005
   b. .001
   c. .003
   d. .002

37.11.05.08 (continued)

7. Backlash must not vary more than:

   a. .020.
   b. .002.
   c. 0.101.
   d. .005.

8. Why should you rotate the differential case a few times?

   a. to seal pinion gears.
   b. to adjust preloead.
   c. to seal side gear.
   d. to seat bearings.

9. You measure backlash with a:

   a. micrometer.
   b. feeler gauge.
   c. dial indicator.
   d. hydrometer.

10. You check backlash in how many different spots around the gear?

   a. 3
   b. 4
   c. 2
   d. 1

LAP TEST ANSWER KEY: CARRIER AND PINION BEARING/ADJUSTING BACKLASH

37.11.05.07

1. C
2. C
3. A
4. D
5. C

37.11.05.08

6. D
7. B
8. D
9. C
10. B

Student: ____________________ File Code: 37.11.02.10.B1-2

Date: ____________________ Date Published: 11-28-77

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

LAP TEST: TRANSMISSION ASSEMBLY

1. Before installation of a transmission assembly, every part should be:

   a. greased thoroughly.
   b. dried completely.
   c. sanded or emery clothed.
   d. heavily lubricated.

2. To install a reverse idler shaft in a transmission using needle bearings, the preferred procedure is to use:

   a. a heavy grease to hold the rollers.
   b. a dummy shaft.
   c. a press.
   d. tweezers.

3. When pins pass through the outer wall of the case, what should you do to prevent them from slipping out?

   a. lead hole in.
   b. stake them.
   c. lubricate them.
   d. glue pin to hole.

4. When installing a new part in a transmission, it is important to try it in the transmission to be sure it:

   a. has excessive play.
   b. has excessive clearance for heat expansion.
   c. wobbles on the shaft.
   d. fits properly.

5. New thrust washers, when assembling a transmission, will provide:

   a. proper end play.
   b. and act as an oil seal.
   c. tight fit with no end play.
   d. a backing mechanism for the shaft.

Student: ______________________ File Code: 37.11.05.00.C1-2 (A)

Date: ______________________ Date Published: 3/15/76

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UNIT POST TEST: DIFFERENTIALS (A)

37.11.05.01.

1. The ring gear is in direct contact with:

   a. a pinion gear.
   b. the propeller shaft.
   c. a special head gear.
   d. the transmission.

2. A way of attaching a hub to an axle is:

   a. using U-joints.
   b. forming a tapper on the axle's end.
   c. using a clutch.
   d. using snap rings.

3. How many different types of axles are there?

   a. 4
   b. 2
   c. 3
   d. 5

4. The most widely-used housing for a differential is:

   a. the forked.
   b. the banjo.
   c. the split.
   d. the strut.

5. One type of differential housing is the:

   a. hanger assembly type.
   b. banjo.
   c. strut.
   d. spring leaf.

37.11.05.02.

6. How many clutch discs are splined to the thrust member? (Chrysler sure-grip)

   a. 4.
   b. 3.
   c. 2.
   d. 6.

7. On a sure-grip differential what is forced to rotate with the differential case?

   a. rear end.
   b. pinion shafts.
   c. transmission.
   d. drive sprocket.

8. How many clutch discs are splined to the differential case? (Chrysler sure-grip)

   a. 3.
   b. 2.
   c. 4.
   d. 6.

9. A Chrysler sure-grip differential's axles side gears are driven by how many pinions?

   a. 3.
   b. 2.
   c. 1.
   d. 4.

10. The thrust member is splined to the:

   a. pinion shaft.
   b. axle.
   c. differential case.
   d. side gears.

37.11.05.03.

11. Before removing the drive shaft, you should:

   a. measure angle of power train.
   b. remove the transmission.
   c. mark universal joints.
   d. remove your exhaust pipe.

12. When the casing is completely stripped down and just before reassembly, you should:

   a. replace all oil seals.
   b. flush housing thoroughly.
   c. put lineshaft back on the precise way you removed it.
   d. fill housing with lubrication.

37.11.05.03. cont.

13. To prevent damage to the oil seal when reinstalling, you:

    a. place a plug in axle hole.
    b. coat axle shaft with lubricant for 6".
    c. apply light heat to soften seal for installation.
    d. install a new seal.

14. You would check for backlash with a:

    a. dial indicator.
    b. feeler gauge.
    c. hydrometer.
    d. micrometer.

15. After taking an axle apart, you should:

    a. heat it for easier dismantling.
    b. wash it.
    c. lubricate it.
    d. cool it.

37.11.05.04.

16. The small end of a seal protector goes in what direction?

    a. it doesn't matter what way it goes in.
    b. pointing toward the pinion gear.
    c. pointing toward splined end of axle shaft.
    d. pointing toward the housing.

17.

18.

19. When you remove a bearing, you do so by:

    a. pressing it off.
    b. applying heat to case so you can slip bearing out.
    c. prying it out.
    d. rapping it out.

37.11.05.04. cont.

20. To remove the axles, you would use a:

    a. pry bar.
    b. spreader.
    c. press jack.
    d. slide hammer type puller.

37.11.05.05.

21. Proper ring and pinion tooth contact pattern is important. The pattern should generally be:

    a. near the top of the tooth and extending over the entire length.
    b. centralized on the tooth.
    c. centralized between the top and bottom of the tooth but closer to bottom.
    d. centralized between top and bottom of the tooth but closer to top.

22. When replacing the pinion flange, if it goes on hard:

    a. heat the flange.
    b. use a puller.
    c. heat the pinion shaft.
    d. drive on with a soft hammer.

23. When attaching the ring gear to the case flange, use:

    a. special fasteners for the purpose.
    b. any fasteners of the right size.
    c. fasteners with split back washers.
    d. double-headed nuts.

24. Axle wheel bearing retainer rings may be removed from the axle after:

    a. chilling.
    b. cutting with a torch.
    c. notching with a chisel.
    d. heating.

25. When tightening pinion flange retaining nut on installation using a collapsible spacer, what must be done if the preload is exceeded?

    a. install new spacers.
    b. back off nut past correct preload and tighten until preload is correct.
    c. leave preload above.
    d. back off nut until preload is correct.

37.11.05.06.

*26. What is a hypoid gear setup as used in the differential?

a. no-slip rear end.
b. pinion gear engages ring gear below the center line.
c. cam clutch in synchronism with the side gear.
d. pinion gear engages ring gear above axle center line.

27. You check ring and pinion tooth contact pattern by:

a. a dial indicator.
b. a feeler gauge.
c. coating ring gear with red lead and oil mixture.
d. applying grease to the pinion gear and rotating gear in a full circle.

28. To regulate or adjust the pinion depth, you:

a. replace the pinion gear.
b. use shims.
c. adjust ring gears.
d. adjust backlash.

29. The toe part of a ring gear is that part which:

a. is centralized between the top and the bottom of the gear.
b. faces the inside of the gear.
c. faces the outside of the gear.
d. is centralized between the top and bottom of the gear heel.

*30. Why is a hypoid used?

a. to facilitate raising the car body.
b. to insure the rear end won't slip.
c. to reduce wear on the clutch plates.
d. to facilitate lowering the car body.

37.11.05.07.

31. To dry bearings, you:

a. let evaporate.
b. use compressed air.
c. apply heat.
d. use a clean rag.

32. When replacing pinion gears and replacing a bearing cup, what do you use to remove the bearing cup?

a. a puller.
b. a screwdriver.
c. a hollow punch.
d. a needle vise pliers.

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1974, p. 274, #s 16, 17, 18, 19.)

37.11.05.07. cont.

33. To clean bearings, you wash them in:

    a. gasoline.
    b. cleaning solvent.
    c. hot soapy water.
    d. diesel fuel.

34. What contains the carrier and pinion bearings?

    a. the transmission.
    b. the differential carrier.
    c. the bell housing.
    d. the clutch plates.

~~35. You install a bearing by:~~

    ~~a. heating and slipping it into position.~~
    ~~b. lubricating and slipping into position.~~
    ~~c. driving it into position.~~
    ~~d. cooling and slipping it into position.~~

37.11.05.08.

36. Why do you rotate differential case a few times?

    a. to adjust prelead.
    b. to seal side gear.
    c. to seal pinion gears.
    d. to seat bearings.

37. Backlash must not vary more than:

    a. .002.
    b. .020.
    c. .101.
    d. .005.

38. You measure backlash with a:

    a. hydrometer.
    b. dial indicator.
    c. micrometer.
    d. feeler gauge.

39. You check backlash in how many different spots around the gear?

    a. 4.
    b. 2.
    c. 3.
    d. 1.

37.11.05.08. cont.

40. For each .001 change in backlash desired, you transfer how many thousands of shims?

    a. .003.
    b. .001.
    c. .005.
    d. .002.

POST TEST

UNIT TEST ANSWER SHEET

Occupational Area: ____________________

File Code: 37.11.05.00.C1-2

Name: ____________________

Family Pay Number ____________________ Sex M F (Circle 1)

ANSWERS

.11.05.01	1.	A	37.11.05.05	21.	B	41.	______
	2.	B		22.	D	42.	______
	3.	C		23.	A	43.	______
	4.	B		24.	C	44.	______
	5.	B		25.	A	45.	______
.11.05.02	6.	C	37.11.05.06	26.	B	46.	______
	7.	B		27.	C	47.	______
	8.	B		28.	B	48.	______
	9.	D		29.	B	49.	______
	10.	B		30.	D	50.	______
.11.05.03	11.	C	37.11.05.07	31.	B	51.	______
	12.	B		32.	A	52.	______
	13.	B		33.	B	53.	______
	14.	A		34.	B	54.	______
	15.	B		[redacted]		55.	______
11.05.04	16.	C	37.11.05.08	36.	D	56.	______
	[redacted]			37.	A	57.	______
	[redacted]			38.	B	58.	______
	19.	A		39.	A	59.	______
	20.	D		40.	D	60.	______

Student: ______________________ **File Code:** 37.11.05.00.C1-2 (B)

Date: ______________________ **Date Published:** 12-6-77

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

UNIT POST TEST: DIFFERENTIALS (B)

37.11.05.01

1. One type of differential housing is the:

   a. hanger assembly type.
   b. banjo.
   c. strut.
   d. spring leaf.

2. The most widely-used housing for a differential is:

   a. the forked.
   b. the banjo.
   c. the split.
   d. the strut.

3. How many different types of axles are there?

   a. 4
   b. 2
   c. 3
   d. 5

4. A way of attaching a jub to an axle is:

   a. using U-joints.
   b. forming a tapper on the axle's end.
   c. using a clutch.
   d. using snap rings.

5. The ring gear is in direct contact with:

   a. a pinion gear.
   b. the propeller shaft.
   c. a special head gear.
   d. the transmission.

37.11.05.02

6. The thrust member is splined to the:

   a. pinion shaft.
   b. axle.
   c. differential case.
   d. side gears.

37.11.05.02 (continued)

7. A Chrysler sure-grip differential's axles side gears are driven by how many pinions?

   a. 3
   b. 2
   c. 1
   d. 4

8. How many clutch discs are splined to the differential case? (Chrysler sure-grip)?

   a. 3
   b. 2
   c. 4
   d. 6

9. On a sure-grip differential what is forced to rotate with the differential case?

   a. rear end.
   b. pinion shafts.
   c. transmission.
   d. drive sprocket.

10. How many clutch discs are splined to the thrust member? (Chrysler sure-grip)

    a. 4
    b. 3
    c. 2
    d. 6

47.11.05.03

11. After taking an axle apart, you should:

    a. heat it for easier dismantling
    b. wash it.
    c. lubricate it.
    d. cool it.

12. You would check for backlash with a:

    a. dial indicator.
    b. feeler gauge.
    c. hydrometer.
    d. micrometer.

13. To prevent damage to the oil seal when reinstalling, you:

    a. place a plug in axle hole.
    b. coat axle shaft with lubricant for 6".
    c. apply light heat to soften seal for installation.
    d. install a new seal.

47.11.05.03 (continued)

14. When the casing is completely stripped down and just before reassembly, you:

a. replace all oil seals.
b. flush housing thoroughly.
c. put lineshaft back on the precise way you removed it.
d. fill housing with lubrication.

15. Before removing the drive shaft, you should:

a. measure angle of power train.
b. remove the transmission.
c. mark universal joints.
d. remove your exhaust pipe.

37.11.05.04

16. To remove the axles, you would use a:

a. pry bar.
b. spreader.
c. press jack.
d. slide hammer type puller.

17. When you remove a bearing, you do so by:

a. pressing it off.
b. applying heat to case so you can slip bearing out.
c. prying it out.
d. rapping it out.

18. The small end of a seal protector goes in what direction?

a. it doesn't matter what way it goes in.
b. pointing toward the pinion gear.
c. pointing toward splined end of axle shaft.
d. pointing toward the housing.

37.11.05.05

19. When tightening pinion flange retaining nut on installation using a collapsible spacer, what must be done if the preload is exceeded?

a. install new spacers.
b. back off nut past correct preload and tighten until preload is correct.
c. leave preload above.
d. back off nut until preload is correct.

20. Axle wheel bearing retainer rings may be removed from the axle after:

a. chilling.
b. cutting with a torch.
c. notching with a chisel.
d. heating.

37.11.05.05 (continued)

21. When attaching the ring gear to the case flange, use:

    a. special fasteners for the purpose.
    b. any fasteners of the right size.
    c. fasteners with split back washers.
    d. double-headed nuts.

22. When replacing the pinion flange, if it goes on hard:

    a. heat the flange.
    b. use a puller.
    c. heat the pinion shaft.
    d. drive on with a soft hammer.

23. Proper ring and pinion tooth contact pattern is important. The pattern should generally be:

    a. near the top of the tooth and extending over the entire length.
    b. centralized on the tooth.
    c. centralized between the top and bottom of the tooth but closer to bottom.
    d. centralized between top and bottom of the tooth but closer to top.

37.11.05.06

24. *Why is a hypboid used?

    a. to facilitate raising the car body.
    b. to insure the rear end won't slip.
    c. to reduce wear on the clutch plates.
    d. to facilitate lowering the car body.

25. The toe part of a ring gear is that part which:

    a. is centralized between the top and the bottom of the gear.
    b. faces the inside of the gear.
    c. faces the outside of the gear.
    d. is centralized between the top and bottom of the gear heel.

26. To regulate or adjust the pinion depth, you:

    a. replace the pinion gear.
    b. use shims.
    c. adjust ring gears.
    d. adjust backlash.

27. You check ring and pinion tooth contact pattern by:

    a. a dial indicator.
    b. a feeler gauge.
    c. coating ring gear with red lead and oil mixture.
    d. applying grease to the pinion gear and rotating gear in a full circle.

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1974, p. 274, #s 16-19).

37.11.05.06 (continued)

28. What is a hypoid gear setup as used in the differential?

   a. no-slip rear end.
   b. pinion gear engages ring gear below the center line.
   c. cam clutch in synchronism with the side gear.
   d. pinion gear engages ring gear above axle center line.

37.11.05.07

29.

30. What contains the carrier and pinion bearings?

   a. the transmission.
   b. the differential carrier.
   c. the bell housing.
   d. the clutch plates.

31. To clean bearings, you wash them in:

   a. gasoline.
   b. cleaning solvent.
   c. hot soapy water.
   d. diesel fuel.

32. When replacing pinion gears and replacing a bearing cup, what do you use to remove the bearing cup?

   a. a puller.
   b. a screwdriver.
   c. a hollow punch.
   d. a needle vise pliers.

33. To dry bearings, you:

   a. let evaporate.
   b. use compressed air.
   c. apply heat.
   d. use a clean rag.

37.11.05.08

34. For each .001 change in backlash desired, you transfer how many thousands of shims?

   a. .003
   b. .001
   c. .005
   d. .002

37.11.05.08 (continued)

35. You check backlash in how many different spots around the gear?

    a. 4
    b. 2
    c. 3
    d. 1

36. You measure backlash with a:

    a. hydrometer.
    b. dial indicator.
    c. micrometer.
    d. feeler gauge.

37. Backlash must not vary more than:

    a. .002
    b. .020
    c. 0.101
    d. .005

38. Why do you rotate differential case a few times?

    a. to adjust prelead.
    b. to seal side gear.
    c. to seal pinion gears.
    d. to seat bearings.

UNIT POST TEST ANSWER KEY: DIFFERENTIALS (B)

1. B
2. B
3. C
4. B
5. A
6. B
7. D
8. B
9. B
10. C
11. B
12. A
13. B
14. B
15. C
16. D
17. A
18. C
19. A
20. C
21. A
22. D
23. B
24. D
25. B
26. B
27. C
28. B
29.
30. B
31. B
32. A
33. B
34. D
35. A
36. B
37. A
38. D

Student: ____________________ File Code: 37.11.05.00.C1-2 (C)

Date: ____________________ Date Published: 6/14/77

Mountain-Plains Education &
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Glasgow AFB, Montana 59231

UNIT POST TEST: DIFFERENTIALS

37.11.05.01

1. The ring gear is in direct contact with:

   a. a pinion gear
   b. the propeller shaft
   c. a special head gear
   d. the transmission

2. One type of differential housing is the:

   a. hanger assembly type
   b. banjo
   c. strut
   d. spring leaf

3. A way of attaching a hub to an axle is:

   a. using U-joints
   b. forming a tapper on the axle's end
   c. using a clutch
   d. using snap rings

4. The most widely-used housing for differential is:

   a. the forked
   b. the banjo
   c. the split
   d. the strut

5. How many different types of axles are there?

   a. 4
   b. 2
   c. 3
   d. 5

37.11.05.02

6. A Chrysler sure-grip differential's axles side gears are driven by how many pinions?

   a. 3
   b. 2
   c. 1
   d. 4

37.11.05.02 cont.

7. How many clutch discs are splined to the thrust member? (Chrysler sure-grip)

   a. 4
   b. 3
   c. 2
   d. 6

8. How many clutch discs are splined to the differential case? (Chrysler sure-grip)

   a. 3
   b. 2
   c. 4
   d. 6

9. On a sure-grip differential what is forced to rotate with the differential case?

   a. rear end
   b. pinion shafts
   c. transmission
   d. drive sprocket

10. The thrust member is splined to the:

   a. pinion shaft
   b. axle
   c. differential case
   d. side gears

37.11.05.03

11. You would check for backlash with a:

   a. dial indicator
   b. feeler gauge
   c. hydrometer
   d. micrometer

12. Before removing the drive shaft, you should:

   a. measure angle of power train
   b. remove the transmission
   c. mark universal joints
   d. remove your exhaust pipe

13. After taking an axle apart, you should:

   a. heat it for easier dismantling
   b. wash it
   c. lubricate it
   d. cool it

37.11.05.03 cont.

14. When the casing is completely striped down and just before reassembly, you should:

    a. replace all oil seals
    b. flush housing thoroughly
    c. put lineshaft back on the precise way you removed it
    d. fill housing with lubrication

15. To prevent damage to the oil seal when reinstalling, you:

    a. place a plug in axle hole
    b. coat axle shaft with lubricant for 6"
    c. apply light heat to soften seal for installation
    d. install a new seal

37.11.05.04

16. The small end of a seal protector goes in what direction?

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    c. pointing toward splined end of axle shaft
    d. pointing toward the housing

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    a. pry bar
    b. spreader
    c. press jack
    d. slide hammer type puller

18. When you remove a bearing, you do so by:

    a. pressing if off
    b. applying heat to case so you can slip bearing out
    c. prying it out
    d. rapping it out

37.11.05.05

19. Proper ring and pinion tooth contact pattern is important. The pattern should generally be:

    a. near the top of the tooth and extending over the entire length
    b. centralized on the tooth
    c. centralized between the top and bottom of the tooth but closer to bottom
    d. centralized between top and bottom of the tooth but closer to top

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    b. back off nut past correct preload and tighten until preload is correct
    c. leave preload
    d. back off nut until preload is correct

37.11.05.05 cont.

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    d. heating

23. When replacing the pinion flange, if it goes on hard:

    a. heat the flange
    b. use a puller
    c. heat the pinion shaft
    d. drive on with a soft hammer

37.11.05.06

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    a. no-slip rear end
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    b. use shims
    c. adjust ring gears
    d. adjust backlash

26. The toe part of a ring gear is that part which:

    a. is centralized between the top and the bottom of the gear
    b. faces the inside of the gear
    c. faces the outside of the gear
    d. is centralized between the top and bottom of the gear

27. Why is a hypoid used?

    a. to facilitate raising the car body
    b. to insure the rear end won't slip
    c. to reduce wear on the clutch plates
    d. to facilitate lowering the car body

*(Adapted from Auto Mechanic Fundamentals, Stockel, Goodheart-Wilcox, 1974, p. 274, #s 16-19.)

37.11.05.06 cont.

28. You check ring and pinion tooth contact pattern by:

    a. a dial indicator
    b. a feeler gauge
    c. coating ring gear with red lead and oil mixture
    d. applying grease to the pinion gear and rotating gear in a full circle

37.11.05.07

29. To clean bearings, you wash them in:

    a. gasoline
    b. cleaning solvent
    c. hot soapy water
    d. diesel fuel

30. You install a bearing by:

    a. heating and slipping it into position
    b. lubricating and slipping into position
    c. driving it into position
    d. cooling and slipping it into position

31. What contains the carrier and pinion bearings?

    a. the transmission
    b. the differential carrier
    c. the bell housing
    d. the clutch plates

32. To dry bearings, you:

    a. let evaporate
    b. use compressed air
    c. apply heat
    d. use a clean rag

33. When replacing pinion gears and replacing a bearing cup, what do you use to remove the bearing cup?

    a. a puller
    b. a screwdriver
    c. a hollow punch
    d. a needle vise pliers

37.11.05.08

34. Why do you rotate differential case a few times?

    a. to adjust prelead
    b. to seal side gear
    c. to seal pinion gears
    d. to seat bearings

37.11.05.08 cont.

35. You check backlash in how many different spots around the gear?

a. 4
b. 2
c. 3
d. 1

36. For each .001 change in backlash desired, you transfer how many thousands of shims?

a. .003
b. .001
c. .005
d .002

37. Backlash must not vary more than:

a. .002
b. .020
c. 0.101
d. .005

38. You measure backlash with a:

a. hydrometer
b. dial indicator
c. micrometer
d. feeler gauge

UNIT POST TEST ANSWER KEY: DIFFERENTIALS (C)

1. A
2. B
3. B
4. B
5. C
6. D
7. C
8. B
9. B
10. B
11. A
12. C
13. B
14. B
15. B
16. C
17. D
18. A
19. B
20. A
21. A
22. C
23. D
24. B
25. B
26. B
27. D
28. C
29. B
30. C
31. B
32. B
33. A
34. D
35. A
36. D
37. A
38. B

Student: ______________________ File Code: 37.11.05.00.B1-5

Date: ______________________ Date Published: 3/10/76

Mountain-Plains Education &
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Program, Inc.
Glasgow AFB, Montana 59231

Family Pay Number: ___________ Sex: M F (Circle 1)

UNIT PERFORMANCE TEST: DIFFERENTIALS

OBJECTIVE 1:

Remove and replace axle bearings and seals.

OBJECTIVE 2:

Remove and repair differential.

TASK:

The student will be assigned a vehicle on which he must replace axle bearings and seals and remove, repair, and adjust the differential.

ASSIGNMENT:

CONDITIONS:

The student may use only those materials provided for the test and must perform the test in the auto shop.

RESOURCES:

Auto needing differential repair
Reference manuals
Time and parts manual
Dial indicators
Feeler gauges
Drain pan
Torque wrench
Jack
Jack stands

RESOURCES: (Continued)

New seals and bearings
Press
Axle puller
Combination Ignition wrench set
Combination Wrench Set
Standard Screwdriver Set
Phillips Screwdriver Set
Feeler gauge - .002 through .025 inch
Hex Key Set
Diagonal Cutting Pliers
Needle Nose Plier
1/4" Drive Socket Set
Ratchet - 3" and 6" extensions - 6" flex handle
Ball Peen hammer
Plastic Tip Hammer
Screw Starter
Chisel and Punch Set
5/32" Pin Punch - 3/16" Solid
Gasket scraper
3/8" Drive Ratchet
3" Extension
Spark Plug Socket
6" Extension
Speed Handle
3/8" Drive Socket Set

Student: ____________________ File Code: 37.11.05.00.B1-5

Date: ____________________ Date Published: 3/10/76

Mountain-Plains Education &
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Program, Inc.
Glasgow AFB, Montana 59231

Family Pay Number: ________ Sex: M F (Circle 1)

PERFORMANCE CHECKLIST:

OVERALL PERFORMANCE: Satisfactory_____ Unsatisfactory_____

	CRITERION	
	Met	Not Met
Objective 1:		
1. Remove and replace axle bearings and seals.		
Criterion: Must meet manufacturer's specifications.		
Objective 2:		
2. Remove and inspect differential.		
Criterion: Does not damage differential; compare parts to		
manufacturer's specifications.		
3. Adjust pinion preload.		
4. Adjust backlash.		
5. Install and test differential.		
Criterion: Must meet manufacturer's specifications.		
6. Complete test in allotted time.		
Criterion: Meet flat rate for assigned vehicle.		
Student must satisfactorily complete 5 of 6 line items to pass test.		